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THE FIFTEENTH YEARBOOK

OF THE

NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

PART I

STANDARDS AND TESTS FOR THE MEASUREMENT OF THE EFFICIENCY OF SCHOOLS AND SCHOOL SYSTEMS

THIS PART OF THE YEARBOOK WILL BE DISCUSSED AT THE DETROIT MEETING OF THE NATIONAL SOCIETY, MONDAY, FEBRUARY 21, 1916, 8:00 P.M. IT WILL ALSO BE DISCUSSED AT THE DETROIT MEETING OF THE NATIONAL COUNCIL OF EDUCATION

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THE FIFTEENTH YEARBOOK

OF THE

NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

+ v

PART I

STANDARDS AND TESTS FOR THE MEASUREMENT OF THE EFFICIENCY OF SCHOOLS AND SCHOOL SYSTEMS

BY

G. D. STRAYER, BIRD T. BALDWIN, B. R. BUCKINGHAM, M. R. TRABUE
F. W. BALLOU, D. C. BLISS, H. G. CHILDS, S. A. COURTIS
E. P. CUBBERLEY, CHARLES H. JUDD, GEORGE MELCHER
E. E. OBERHOLTZER, J. B. SEARS, DANIEL STARCH, G. M. WHIPPLE

Edited by GUY MONTROSE WHIPPLE, *Secretary*

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EDITOR'S PREFACE

It will be recalled that the National Society for the Study of Education one year ago published as its *Fourteenth Yearbook*, Part I, the 1915 report of the Committee of the Department of Superintendence of the National Education Association on Economy of Time in Education, Superintendent H. B. Wilson, chairman. It was anticipated at that time that the policy of this Society in publishing Yearbooks *before* the meeting at which they were to be discussed would measurably augment interest in the report and increase the effectiveness of its discussion. This anticipation was so fully realized that, now that the further report of the Committee on Economy of Time has been unavoidably delayed, it is a matter of satisfaction to be able, nevertheless, to continue our policy by presenting to our members, as Part I of the *Fifteenth Yearbook*, the report of another important committee, the Committee of the National Council of Education of the National Education Association on Standards and Tests of Efficiency, Professor G. D. Strayer, chairman.

The perusal of the Table of Contents will suffice to show that this Yearbook maintains the high standards set by its predecessors in the selection of subject-matter that bears directly upon educational problems of recognized importance and in the selection of contributors that guarantee a presentation worthy of careful consideration.

G. M. W.

INTRODUCTION

In the pages which follow, the Committee on Standards and Tests of the National Council of Education presents a series of reports prepared by its own members and by others who have, upon invitation of the committee, been willing to contribute results of their study or investigation. The committee feels that these reports furnish most satisfactory evidence of the progress which has been made in the field of educational measurement during the past few years. The papers of the several contributors may, in general, be classified as contributing (1) to the derivation of scales or units of measurement, and (2) to the application of such units or scales of measurement as have been derived in the field of educational administration or supervision. In printing, the papers have been grouped as indicated above.

It seems unnecessary with this report in hand to argue in favor of the use of the more precise methods of measurement which have recently been developed. Those interested in the improvement of our schools have always attempted by some method or other to estimate the efficiency of individual schools or school systems. Often this measurement has been based upon an opinion not acceptable to another student or investigator, and not frequently upon attempts to measure which have been extremely crude. The examination system as we have commonly had it, not only has been responsible for judgments with respect to the efficiency of schools, or of school systems, but has also determined in very considerable measure in most school systems the progress of children. In the studies which are reported here, more precise measures give to the student of education a better basis in knowledge of conditions upon which to base his criticism or to develop his improved method of instruction or administration. The measurement of results of any sort, whether of the achievements in school subjects, of the cost of any unit or function, or of the rate of progress, and the like, furnishes primarily a knowledge of the situation which makes clear the problems involved, and which may suggest a method of experiment that looks toward the improvement desired.

Regardless of the development which may be made in the field of measurement, we shall always have to deal with the problem of aim in

education. Those who have done most to develop precision in measurement, or who have profited most by using the units or scales, would be the last to deny the worth of that thinking and discussion which leads to a determination of the ends to be realized in our schools. When one has defined purposes or ends to be achieved, efficiency, in the light of these aims, can be determined only as we are able to measure the degree to which improvement or growth has taken place. Indeed, education may be best defined in terms of changes which are brought about in the individuals subjected to the process. If our aims mean anything to those who teach, they are or are not satisfied, in proportion as measurable changes are brought about in pupils. The more precisely we are able to measure the development which is brought about by virtue of our school work, the more certain we may be that we are realizing the aims which we have set up, and it is only by means of some sort of measurement that we may even claim to have made progress in the accomplishment of those ends which we profess to seek.

GEORGE DRAYTON STRAYER, *Chairman*

PART I

EDUCATIONAL SCALES AND UNITS OF MEASUREMENT

CHAPTER I

A MEASURING SCALE FOR PHYSICAL GROWTH AND PHYSIOLOGICAL AGE

BIRD T. BALDWIN
Professor of Psychology and Education, Swarthmore College

A comparative study of the results of four hundred investigations on over one million individuals shows that the height, weight, and lung capacity of children vary according to nationality, heredity, general social status, urban and rural conditions, geographical distribution, season of the year, normal and abnormal mentality, health, sex, initial size, and stages of physiological maturity. Among the marked modifying factors which have, to a considerable extent, made data incomparable are to be found the manner in which measurements have been taken and recorded; the personal equation of trained and untrained examiners; the varying degrees of accuracy of measuring apparatus; the age of the child, as based on exact birthday, last birthday, or next birthday, with or without months, weeks, and days being taken into consideration; and the measurement of children with or without clothing.

This paper aims to formulate tangible norms which may be used by physical directors and teachers as standards for comparison with all types and races of children between the ages of five and one-half and eighteen years. The norms are based on the best available data in this country from the Horace Mann School, the Francis W. Parker School, and the University Elementary and High schools of the University of Chicago, where a limited number of American children were measured consecutively for several years by trained anthropometrists using standardized apparatus of minute units, with the age recorded exactly in days. Details and

source material have been published elsewhere,[1] but the material and charts included in this article are new and supplementary to the previous larger study.

GENERAL PRINCIPLES OF GROWTH

These norms, in accordance with facts previously published by the writer, conform with the conclusions that: Boys are taller, heavier, and have better lung capacity than girls except during the early adolescent period, when the converse of this statement is true. The widest ranges of individual differences and the largest increments of growth are during adolescence. Individual growth curves previously published show that in the course of growth short children do not become tall, neither do tall children become short, under normal conditions; each child holds his or her relative position in reference to a given median or norm throughout the school age—that is, in a well-developed child weight, height, and lung capacity are relatively proportionate to each other. If a child's weight is divided by its height, the *weight-height coefficient* is found, which is approximately the same for a well-developed large child or a similarly well-developed small child; the same relationship holds true for the breathing capacity and height or the so-called *vital-height coefficient.* (See score card for norms.)

STAGES OF PHYSIOLOGICAL MATURATION OR PHYSIOLOGICAL AGE

Growth is a continuous process, but some periods in the life of a child are marked by more acceleration than others. The period from six to seven and a half is a period of rather rapid growth in height. Boys and girls above median or average height between the ages of six and eighteen grow in stature and physiological maturity in advance of those below the median or average height. There is a shifting of the accelerated period according to the individual's relative height, weight, and lung capacity.

Our study of thirty thousand measurements in height, weight, and lung capacity reveals correlations in growth for boys and girls above the median or average height different from those below. The rhythms and fluctuations of growth in height for the children above the median show that these boys and girls are physiologically older than those

[1] B. T. Baldwin, "Physical Growth and School Progress," *U.S. Bureau of Education, Bulletin No. 10,* 1914. Whole No. 581. 215 pp.

below the median, since their periods of acceleration and arrest begin earlier and end earlier. Short children continue their growth longer than tall children.

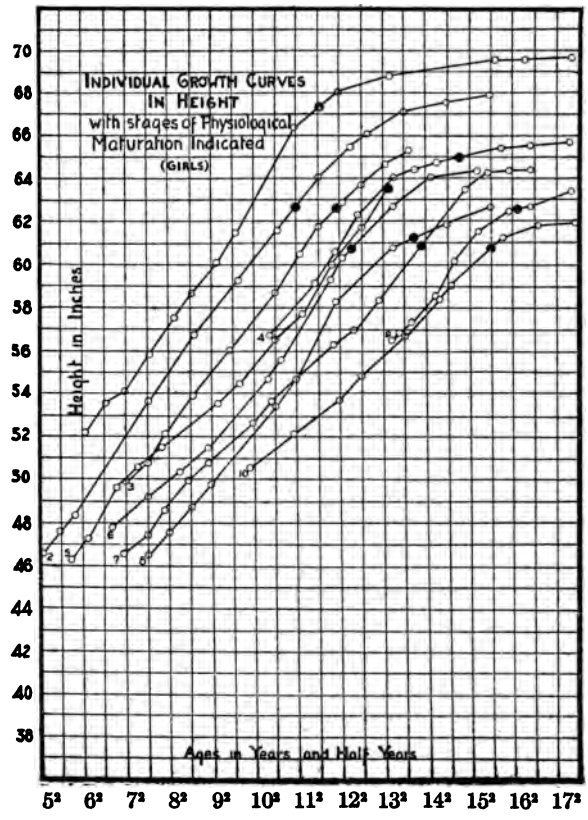

CHART I.—Individual growth-curves

This conclusion may be substantiated in another way. Chart I gives individual growth-curves and the periods of first menstruation of some girls who were selected, on the basis of height only, from a larger group. A study of these curves will show that the taller girls, as a rule, mature earlier than the shorter ones, as shown by the distribution of the advent of first menstruation. It would appear, therefore, that

height, weight, and breathing capacity offer good objective criteria for determining this factor in pubescent development and the onset of maturity. If the girl is tall, healthy, and well nourished, this physical stage may be reached as early as eleven years in a normal girl; if she is tall, but under weight, it may be delayed; if she is very short and markedly light, it may be delayed until sixteen and one-half years of age.[1] This principle of growth has recently been upheld by Weissenberg,[2] who found girls who menstruated before thirteen years of age were, on the average, 150.5 centimeters tall, and those who had not developed so far at fifteen years of age were, on the average, 144.5 centimeters tall. In his study of 1,273 Jews and 768 Russians he found the average of this stage of maturation to be for the Jews fourteen years and two months, and for the Russians fourteen years and eleven months. Jamasaki found the age to be fifteen for Japanese girls and seventeen for Chinese, on the average. All of these are relatively short peoples. These differences in ages are no doubt also greatly influenced by racial and climatic conditions.

In order to determine the wide range of ages which are characteristic of the stages of physiological growth which are entered into at the age of adolescence, the writer and one of his advanced students at Johns Hopkins University, Charles F. Pennington, checked very carefully some material that was gathered by Director William Burdick and Dr. Brown on the ages of pre-pubescence, pubescence, and post-pubescence in boys.[3] In Baltimore 3,600 boys of a "motor" type of development, that is, those taking part in athletics, were examined and checked by Dr. Burdick and supplemented by a group of 1,317 boys from 14 counties of Maryland. Various criteria have been used to determine the age of pubescence, such as examination of the teeth, the bones of the wrist, the change of voice, the color of the eye, and the acceleration in height, weight, and lung capacity. With this particular material the

[1] The coefficient of correlation for these ten cases by the Spearman Formula, $R=1-\frac{\Sigma g}{(n^2-1)}$, is .697.

[2] S. Weissenberg, *Das Wachstum des Menschen.* Stuttgart: Strecker und Schröder, 1911. 220 pp.

[3] These data were collected under the auspices of the Baltimore Public Athletic League of which Mr. Robert Garret is chairman and Drs. Burdick, Brown, Horrax, and Thompson are medical supervisors.

criterion was that of pubescent growth and pigmentation of fine hair, which characterizes a very brief period of time marking the change from asexual to sexual life, when the ability to procreate is established.

Chart II (see p. 16) gives the results of this investigation. Curves 1, 3, and 5, solid lines, represent the 1,317 country boys. Curves 2, 4, and 6, dotted lines, represent the 3,600 city boys. It will be noticed that the pre-pubescent boys range from eight and one-half to sixteen years of age in the group of country boys, and from nine and one-half to seventeen and one-half for the city boys. The post-pubescent ages range from eleven and one-half to twenty-four for the country boys and twelve and one-half to twenty-four for the city boys. For the pubescent stages the country boys range from nine and one-half to fifteen and one-half, with the mode at thirteen and one-half, and the city boys from ten to eighteen, with the mode at fourteen. The average is 13.86 years for the country boys and 14.40 years for the city boys. Crampton[1] found the mean age for pubescence (maturing) for New York boys to be 13.44 years, with a range from twelve and one-half to seventeen and one-half years.

The table shown on p. 17 gives the distribution of 1,241 pre-pubescent, pubescent, and post-pubescent girls from the Baltimore Public Athletic League where the criteria were the menstrual flow, the appearance of subcutaneous fat, enlargement of the breasts, and axillary hair.

All this material indicates that averages are of little value in the study of physical development. What is needed are individual growth records, for each individual must be studied on the basis of his own development. Two children fifteen years of age may vary from each other at least four years in their stages of physiological development—a fact which should be taken into consideration in all educational work, whether physical or mental. The results of the writer's previous study show that the stages of physical and mental maturity are parallel, irrespective of precocity or brightness; therefore, the obvious educational corollary is that our school systems, public and private, should take into careful consideration *the physiological age and the accompanying stages of mental maturity* of boys and girls, rather than the chronological age and brightness, as is now done. This would require that tall,

[1] C. W. Crampton, "Anatomical or Physiological Age versus Chronological Age," *Ped. Sem.*, XV, 230–37.

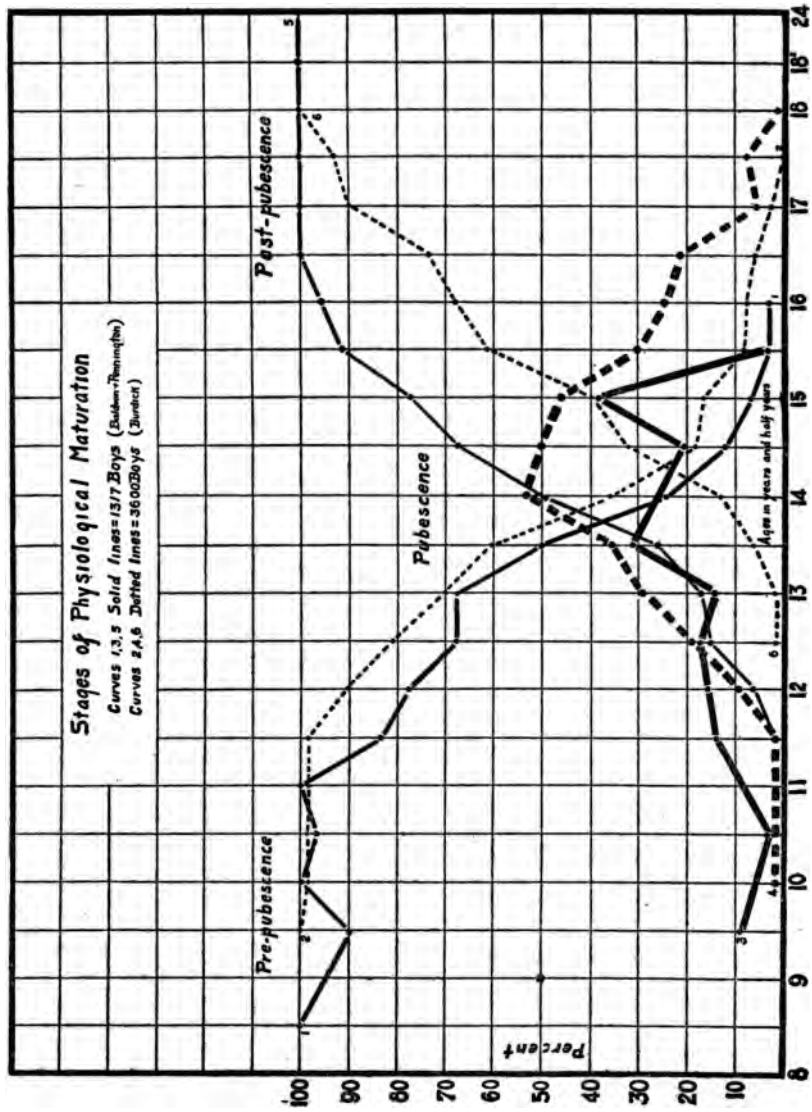

CHART II.—Distribution chart of pre-pubescent, pubescent, and post-pubescent boys

healthy children of accelerated physiological development be encouraged to proceed through school as rapidly as possible within the limits of thoroughness, and that the small, light children of retarded physiological

APPEARANCE OF PUBESCENT CHANGES IN 1,241 GIRLS

Age	No. Pre-pubescent	Percentage	No. Pubescent	Percentage	No. Post-pubescent	Percentage
6½	4	100.0	.....	.....	.....	.....
7	12	100.0	.....	.....	.....	.....
7½	16	100.0	.....	.....	.....	.....
8	6	100.0	.....	.....	.....	.....
8½	26	100.0	.....	.....	.....	.....
9	22	100.0	.....	.....	.....	.....
9½	37	100.0	.....	.....	.....	.....
10	26	100.0	.....	.....	.....	.....
10½	45	93.75	3	6.25	.....	.....
11	27	100.0	.....	.....	.....	.....
11½	41	78.84	10	19.23	1	1.92
12	18	62.06	11	37.93	.....	.....
12½	39	58.20	16	23.88	12	17.91
13	17	39.53	15	34.88	11	25.58
13½	10	15.15	25	37.87	31	46.96
14	10	15.38	25	38.46	30	46.15
14½	3	4.83	11	17.74	48	77.42
15	.....	.....	8	14.54	47	85.45
15½	1	1.55	5	7.81	58	90.62
16	1	2.04	3	6.12	45	91.83
16½	.....	.....	2	3.17	61	96.83
17	.....	.....	.....	.....	43	100.0
17½	.....	.....	.....	.....	43	100.0
18	.....	.....	.....	.....	32	100.0
18½	.....	.....	.....	.....	33	100.0
19	.....	.....	.....	.....	9	100.0
19½	.....	.....	.....	.....	25	100.0
20	.....	.....	.....	.....	15	100.0
20½	.....	.....	.....	.....	18	100.0
21	.....	.....	.....	.....	4	100.0
21½	.....	.....	.....	.....	14	100.0
22+	1 (22 yrs.)	.60	.....	.....	165	99.4
Total	362	.....	134	.....	745	.....
Grand total	.....	.....	.....	.....	1,241	

development be kept below or in the normal grade, doing supplementary work, *since these short, light pupils are immature in mental development, although in many cases precocious in degree of brightness.* It also follows from this study that rapid, healthy growth favors good mental

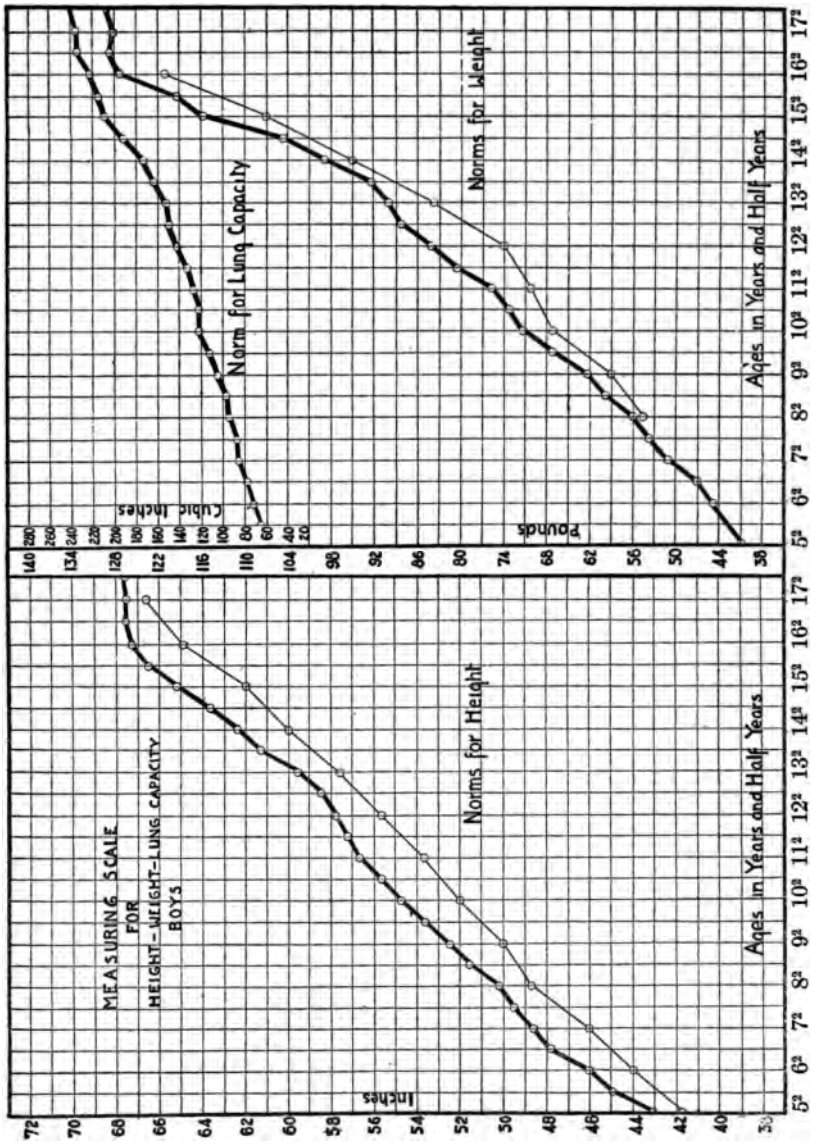

CHART III.—Average growth-curves in height, weight, and lung capacity. The heavy lines are Baldwin's and the light lines are those of Boas. (Place the child's measurements in the assigned spaces on the card and plat the growth-curves on this chart from year to year.)

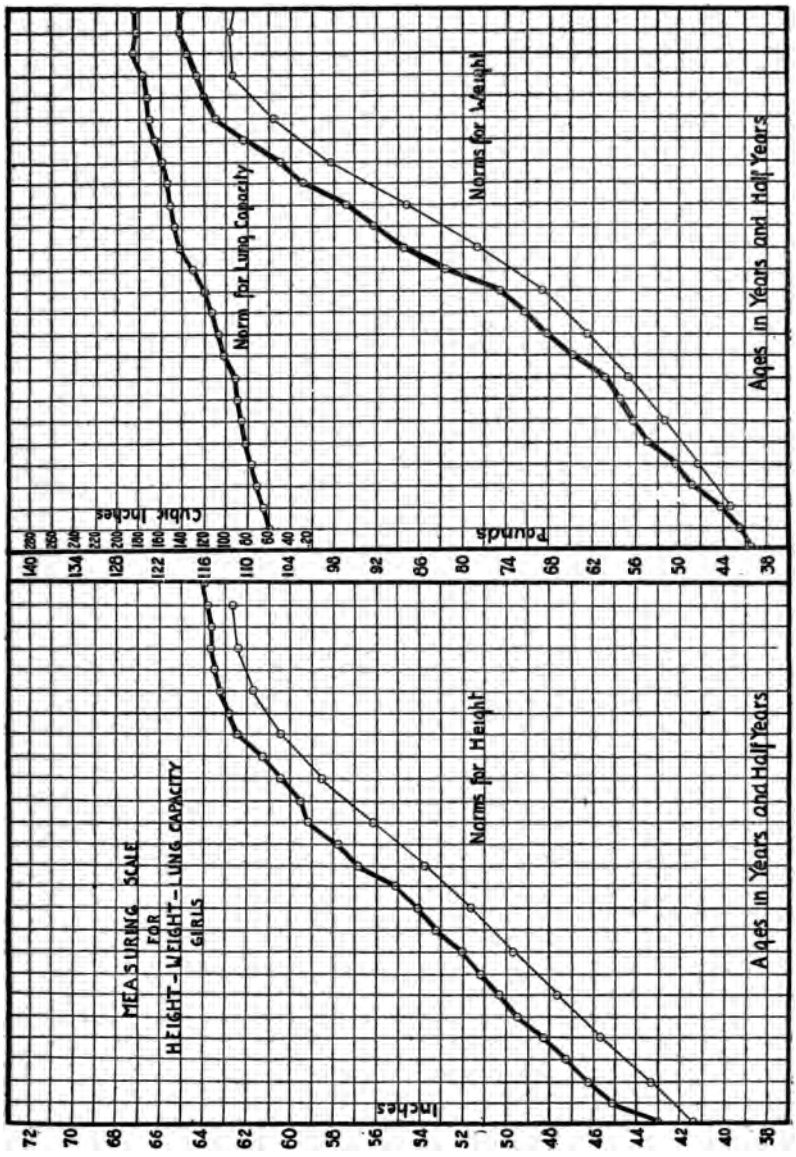

CHART IV.—Average growth-curves in height, weight, and lung capacity. The heavy lines are Baldwin's and the light lines are those of Boas. (Place the child's measurements in the assigned spaces on the card and plat the growth-curves on this chart from year to year.)

MEASURING SCALE FOR PHYSICAL DEVELOPMENT (GIRLS)

English System — Form I

Name..... Schools.....

Date of Birth..... Nationality..... Examiners.....

Date of examination													
School year	Kg.	1		2		3		4		5		6	
Age	5[a]	6	6[a]	7	7[a]	8	8[a]	9	9[a]	10	10[a]	11	11[a]
Norm in inches	42.9	45.2	46.3	47.2	48.3	49.4	50.4	51.1	52.0	53.3	54.0	55.2	56.9
Height													
Weight-height coefficient	.93	.92	.95	1.02	1.04	1.11	1.13	1.13	1.18	1.22	1.33	1.36	1.46
Norm in pounds	40.1	41.7	44.2	48.1	50.4	54.7	57.1	57.5	61.5	64.8	71.7	74.9	82.8
Weight													
Norm in cubic inches	40.0	60.0	63.0	71.3	77.9	81.8	83.5	87.3	91.7	100.9	106.7	114.0	119.0
Breathing capacity													
Vital-height coefficient	.93	1.33	1.36	1.51	1.61	1.65	1.66	1.71	1.76	1.89	1.98	2.07	2.09

Date of examination													
School year	7		8		9		10		11		12		
Age	12	12[a]	13	13[a]	14	14[a]	15	15[a]	16	16[a]	17	17[a]	
Norm in inches	57.7	59.3	59.5	60.5	61.3	62.5	62.6	63.3	63.5	63.7	63.4	63.9	
Height													
Weight-height coefficient	1.51	1.55	1.62	1.69	1.73	1.76	1.84	1.83	1.84	1.85	1.86	1.86	
Norm in pounds	87.1	91.8	96.4	102.3	105.8	110.3	115.3	115.6	116.9	117.9	119.0	119.0	
Weight													
Norm in cubic inches	128.0	141.3	146.2	147.7	153.5	158.8	164.5	172.6	176.5	178.8	183.0	185.0	
Breathing capacity													
Vital-height coefficient	2.22	2.38	2.46	2.44	2.52	2.54	2.63	2.73	2.53	2.81	2.89	2.90	

These norms represent well-developed children with school-medical inspection and physical training. A small child for a given age may be well developed if the *coefficients*, height, weight and breathing capacity relationships, are normal and approximate those indicated. The formula is

Weight ÷ height = weight-height coefficient.
Breathing capacity ÷ height = vital-height coefficient.

For example. For 5[a] years, 41 lbs ÷ 43 in. = .95 = weight-height coefficient.

In the metric system use height in centimeters, weight in kilograms, and breathing capacity in liters. The English weight-height coefficient norms × .179 = metric weight-height coefficient norms. The English vital-height coefficient norms × .00645 = metric vital-height coefficient norms.

School year..... 1 2 3 4 5 6 7 8 9 10 11 12 | 1 2 3 4 5 6 7 8 9 10 11 12 | 1 2 3 4 5 6 7 8 9 10 11 12

Health.....	Vision.....	Hearing.....	
Vaccination.....	Glands.....	Posture.....	

Note: G = Good M = Medium P = Poor C = Corrected

MEASURING SCALE FOR PHYSICAL DEVELOPMENT (BOYS)

English System — Form I

Name..... Schools.....

Date of birth..... Nationality..... Examiners.....

Date of examination													
School year	Kg.	1		2		3		4		5		6	
Age	5[a]	6	6[a]	7	7[a]	8	8[a]	9	9[a]	10	10[a]	11	11[a]
Norm in inches Height	43.0	45.4	46.6	47.9	48.3	49.5	50.1	51.4	52.2	53.6	54.8	55.3	56.7
Weight-height coefficient	.95	.95	.96	.98	1.07	1.09	1.12	1.17	1.19	1.23	1.30	1.33	1.33
Norm in pounds Weight	41.0	42.9	44.8	46.9	51.7	54.2	55.9	60.4	62.1	66.9	71.4	73.2	75.5
Norm in cubic inches Breathing capacity	50.0	65.6	70.0	77.2	82.4	85.6	92.6	95.7	105.9	111.5	123.2	12	126.2
Vital-height coefficient	1.160	1.44	1.50	1.61	1.71	1.73	1.85	1.86	2.03	2.05	2.28	2.21	2.22

Date of examination													
School year	7		8		9		10		11		12		
Age	12	12[a]	13	13[a]	14	14[a]	15	15[a]	16	16[a]	17	17[a]	
Norm in inches Height	57.1	57.8	58.2	59.5	61.0	62.2	63.7	65.1	66.3	67.4	67.5	67.5	
Weight-height coefficient	1.42	1.46	1.52	1.51	1.55	1.59	1.65	1.78	1.79	1.88	1.90	1.88	
Norm in pounds Weight	81.0	84.6	89.5	90.0	94.9	98.9	104.9	115.9	118.9	127.1	128.5	127.0	
Norm in cubic inches Breathing capacity	134.0	140.5	150.8	152.9	162.5	173.8	191.7	210.0	212.6	222.6	236.4	238.0	
Vital-height coefficient	2.35	2.52	2.58	2.55	2.66	2.77	3.00	3.23	3.21	3.30	3.50	3.53	

These norms represent well-developed children with school-medical inspection and physical training. A small child for a given age may be well developed if the *coefficients*, height, weight and breathing capacity relationships, are normal and approximate those indicated. The formula is

Weight ÷ height = weight-height coefficient.
Breathing capacity ÷ height = vital-height coefficient.
For example: For 5[a] years, 41 lbs. ÷ 43 in. = .95 weight-height coefficient.
In the metric system use height in centimeters, weight in kilograms, and breathing capacity in liters. The English weight-height coefficient norms × .179 = metric weight-height coefficient norms. The English vital-height coefficient norms × .00645 = metric vital-height coefficient norms.

School year..... 1 2 3 4 5 6 7 8 9 10 11 12 | 1 2 3 4 5 6 7 8 9 10 11 12 | 1 2 3 4 5 6 7 8 9 10 11 12[a]

Health.....	Vision.....	Hearing.....	
Vaccination.....	Glands.....	Posture.....	

Note: G = Good M = Medium P = Poor C = Corrected.

development, and therefore that the healthy growing child should have plenty of physical and mental exercise.

THE MEASURING SCALE

In order that teachers, principals, superintendents, physical directors, and parents may have a basis for comparison in the study of physical development, the writer has formulated norms for physical growth in height, weight, and lung capacity, and expressed them on the accompanying cards (pp. 20–21), which may be used as a *measuring scale* for physical growth and stages of physiological maturity, as well as for records concerning physical conditions. The norms are high, representing the best developed children available, who have had physical training, school-medical inspection, directed play, and remedial treatment where necessary. A child who falls short of these standards is not necessarily subnormal physically, providing its weight and breathing capacity are proportionate to its height. The weight-height coefficients and the vital-height coefficients indicated on the card under their respective ages mark the norm to which all well-developed children should approximate.[1] All these norms are based upon measurements of nude children.

[1] Measuring scales for the growth of boys and girls have been prepared in the metric system and may be had from the writer on application. An illustrated leaflet describing methods of measuring and tests for nutrition, vision, hearing, neck-glands, and posture may also be obtained from the writer.

CHAPTER II

NOTES ON THE DERIVATION OF SCALES IN SCHOOL SUBJECTS: WITH SPECIAL APPLICATION TO ARITHMETIC

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The movement to set up objective means of measuring school products, which has been so characteristic of recent educational practice, has plainly demonstrated the necessity for more and better instruments of measurement. It is in response to this need that standards of achievement have been set up, and scales have been derived. The latter have been of two kinds—those based upon the judgment of competent persons, and those based upon the ratio of correct to total responses in a typical group. The validity of each of these bases has been questioned, but not successfully. The superiority of the one over the other has been argued, but not conclusively. In fact, there is no opposition between them.

The determination of the ratio of correct responses to total responses is also, to some extent, dependent upon individual judgment, because it is frequently a matter of opinion whether a response is correct or not. In the matter of spelling, for instance, it is not always easy to say whether a given form is or is not to be scored as correct. Again, in arithmetic, which, like spelling, is capable of relatively precise rating, it is frequently difficult to decide whether the answer to a problem should be rated as correct. In such cases readers of papers will differ somewhat in their conclusions. In other words, the element of individual judgment plays a part. Furthermore, such subjects as geography, history, and English offer much greater degrees of difficulty in the application of that precision of rating upon which the ratio method of deriving scales is based.

Finally, in the gradation of school subjects from the most definite subjects (spelling and arithmetic) to the least definite ones (penmanship, drawing, and English composition), we reach subjects in which the element of certainty is at a minimum, and judgment plays its most important rôle.

The point which I am seeking to make is this: that there is no opposition between scales based upon judgment and those based on the ratio of correct to total responses, and that each method of derivation is most appropriate at the extremes of a series of school subjects ranging from most definite to least definite.

On the score of penmanship, drawing, and English composition, a given specimen of work is superior to another, not because it is more correct, but just because people think it is superior. On the other hand, in the case of spelling, a list of words written by one child is better in point of spelling than a list written by another child, not because a number of judges think it is the better, but because there are actually more words spelled correctly in it.

In those subjects that range between the extremes of definiteness (such subjects, namely, as geography, history, and grammar) it will be evident that there is place for both the judgment and ratio methods of scale-derivation. In each of these subjects there are certain parts which are so definite and about which people differ so little that there is small room for variation in judgment. In geography, for example, locational features are of this type. It is no more possible for people to differ about the state of the United States in which Kalamazoo is than it is for them to differ about the correct spelling of "separate" or the product of seven and nine. Similarly, in history, the question "In what year was the Stamp Act passed?" admits of no debate. And, again, in grammar, the direction "Give an example in a sentence of an adverb of time, and underline it" admits of responses which may be classified, with practical certainty, as either right or wrong.

It will be noted that the questions just mentioned call for responses based on information, and it is a fact that most questions which may be rated with precision as either right or wrong are of this kind. It is obvious, however, that a large part of geography, and perhaps a still larger part of history and grammar, cannot be covered by questions of this character. Indeed, the most valuable training to be derived from these subjects is based upon the opportunity which they afford for comparison, for inference, and for judgment.

But there is no good reason why scales based upon the ratio idea should not be derived for those phases or parts of these subjects that are susceptible of the precise treatment which the ratio idea requires. In fact, it is becoming increasingly evident that the present general scales

will have to give place to more specific ones, each scale being suitable for a particular purpose and applicable to a given condition or situation. We shall have scales for each grade in spelling, scales for the several styles of handwriting, and scales for each type of discourse in composition. Why, then, should we not have scales for information in geography, history, and grammar?

The suggestion may be made at this point that in using scales based upon information, we may not only directly measure ability to give information, but we may also indirectly measure ability of a more general sort, including the power to think. Work is now being done on the problem of the correlation between information and general ability within a school subject. From present indications there is reason to suppose that the correlation is high—probably not less than 0.80. If this is substantiated by sufficient data, it then becomes reasonably easy to measure something like general ability in a given field in terms of a scale derived from questions of information.

The practicability of indirect measurement is demonstrated in many of our ordinary measurements. We do not measure, for instance, the heat of the atmosphere, but, rather, the length of a mercury column, which varies directly with the amount of heat to which it is subjected. We do not measure the health of a child, but, rather, his vital index, because we either know, or think we know, that his health varies approximately with this index.

When we use the phrase "varies directly," we are stating a condition which involves perfect correlation. No such perfect correlation, of course, exists between mental processes. A measure, therefore, of one process, trait, or ability in terms of another, is liable to a margin of error to the extent that the correlation is imperfect. If we may assume that the correlation between information and thought-power in geography is 0.80, we cannot get a perfect measure of "thought-power" from "amount of information," but we can get a measure which differs from the true one by an amount small enough to be negligible for many practical purposes.

With these ideas in mind, an investigation was begun in the fall of 1913, which had for its purpose the development of standardized material and the derivation of scales in the subjects of arithmetic, geography, history, and grammar, upon the basis of the ratio of correct to total responses to given questions. It is to be understood that in the rating

of pupils' papers, all answers were scored as either correct or not correct, and that no part credits were given.

The report herewith submitted is preliminary and fragmentary. It is preliminary because it is not believed that a sufficient number of cases have been scored to make the conclusions as reliable as they should be. It is fragmentary because results are shown only for the subject of arithmetic, and within this subject, for only a portion of the questions that were used. It is offered here as an example of the extension to a wider field of a previously used method.

The problems used in this report were given to seventh- and eighth-grade children in eight schools in New York City, and to children of the same grades in ten other cities. Not all the problems were used in every city. The number of participants, therefore, varies with different questions. In no case, however, was a problem attempted by less than 5,000 children.

The tests were administered by the class teachers, under instructions. The principal point in the instructions was that the problems were to be written on the blackboard, one at a time, and that ten minutes were to be allowed the pupils for solving each problem.

In rating the papers, children were scored as correct only in case the answer to the problem was correctly given. In a few instances, where the teacher had evidently presented an example incorrectly, and the change did not affect its nature or apparent difficulty, it was scored as correct if the pupils gave the right answer under the changed condition. In the few instances where changes were introduced by the teacher which affected the nature and difficulty of the problem, no record was taken of the results.

The problems listed under Table I were given, in a preliminary test, to children in several cities other than New York City, and in a test of eight schools of a certain type in New York City, on March 23, 1915. In order to distinguish them from the problems shown under Table II, they are called the "March test."

The problems listed under Table II were given, in a preliminary test, to children in a number of cities other than New York City, and were then given, also, to the same eight schools of New York City, on June 24, 1915. For convenience in designation, these problems are called the "June test."

TABLE I

DISTRIBUTION OF CORRECT ANSWERS BY QUESTIONS AND BY GRADES
ARITHMETIC. MARCH TEST

PROBLEM NUMBERS	SEVENTH GRADE				EIGHTH GRADE				TOTAL	
	FIRST HALF		SECOND HALF		FIRST HALF		SECOND HALF			
	No. of Participants	No. Correct	No. of Participants	No. Correct	No. of Participants	No. Correct	No. of Participants	No. Correct	No. of Participants	No. Correct
1.....	1,526	143	1,798	201	1,296	308	1,304	520	5,924	1,172
2.....	1,526	362	1,788	557	1,296	586	1,304	804	5,924	2,309
3.....	1,525	681	1,635	898	1,177	785	1,261	963	5,598	3,327
4.....	1,527	533	1,636	700	1,177	628	1,260	913	5,600	2,774
5.....	1,527	544	1,636	801	1,177	669	1,260	885	5,600	2,899
6.....	1,594	425	1,577	558	1,198	528	1,248	678	5,617	2,189
7.....	1,594	816	1,577	985	1,198	869	1,248	985	5,617	3,655
8.....	1,594	539	1,604	695	1,214	628	1,248	862	5,660	2,724
9.....	1,594	751	1,604	833	1,214	753	1,248	821	5,660	3,158
10.....	1,594	635	1,604	804	1,214	671	1,248	909	5,660	3,019

The ten problems used in the March test are the following, their numbers corresponding to the numbers in the table above:

1. If a map 10 in. wide and 16 in. long is made on a scale of 50 mi. to the inch, what is the area in square miles that the map represents?

2. Cream is sold in ½-pint bottles. If a milkman buys it at $1.20 a gallon and it costs 40 cents a gallon to bottle and deliver it, at what price per bottle must it be sold to gain 20 per cent?

3. A fruit dealer bought 300 apples at the rate of 5 for a cent, and 300 at 4 for a cent. He sold them all at the rate of 8 for 5 cents. What did he gain on the investment?

4. A family used 1½ bu. of potatoes a month. How much will be saved each month by buying them at $1.30 a bushel instead of at 8 cents a quart? (8 qts. = 1 pk.; 4 pks. = 1 bu.)

5. James buys papers at 10 for 6 cents and sells them at 1 cent each. If his sales average 100 a day for 6 days, what does he add to the family income after keeping $0.10 for himself?

6. The 7A class has 42 on the roll and only 3 absent today; and the 7B class has 48 on the roll with 4 absent. Which has the better percentage of attendance and how much?

7. Bought pencils at $1.20 per gross, and sold them at 1 cent each. Find the gain per cent.

8. A family pays $25 a month for a non-heated flat and uses 5 tons of coal at $7 per ton for heating purposes during the winter. If it moved to a steam-heated flat at $30 a month, would it increase its expenses for the year or not, and how much?

9. The value of the men's factory products in the leading centers of the United States was as follows:

	1860	1900
New York	$17,011,370	$103,220,201
Baltimore	3,124,342	17,290,825
Boston	4,567,749	8,601,431
Chicago	540,709	36,094,310
Philadelphia	9,962,800	18,802,637

Find the increase or decrease in the value of the men's factory products in 1900 as compared with that of 1860.

10. Two boys made a gallon of lemonade, using 16 lemons at 30 cents a doz. and 2 lbs. of sugar at 6 cents a pound. They sold it at 5 cents a glass, 6 glasses to a quart. How much was each boy's share of the gain?

TABLE II

DISTRIBUTION OF CORRECT ANSWERS BY QUESTIONS AND BY GRADES
ARITHMETIC. JUNE TEST

Problem Numbers	Seventh Grade				Eighth Grade				Total	
	First Half		Second Half		First Half		Second Half			
	No. of Participants	No. Correct	No. of Participants	No. Correct	No. of Participants	No. Correct	No. of Participants	No. Correct	No. of Participants	No. Correct
1	1,505	313	1,478	358	1,163	354	1,104	515	5,250	1,540
2	1,442	152	1,454	189	1,091	167	1,166	277	5,153	785
3	1,442	796	1,454	933	1,091	750	1,166	922	5,153	3,401
4	1,508	988	1,544	1,164	1,129	881	1,192	991	5,373	4,024
5	1,442	978	1,499	1,192	1,091	931	1,134	1,046	5,166	4,147
6	1,508	452	1,544	653	1,129	515	1,192	696	5,373	2,316
7	1,526	778	1,754	1,108	1,257	898	1,261	988	5,798	3,772
8	1,442	556	1,454	783	1,091	593	1,124	801	5,111	2,733
9	1,594	481	1,604	616	1,214	572	1,248	785	5,660	2,454
10	1,442	519	1,454	724	1,091	514	1,124	774	5,111	2,531

The ten problems used in the June test are the following, their numbers corresponding to the numbers in the table above:

1. A farmer has a herd of 12 dairy cows that average 22 pounds each of milk per day. The milk contains 3.8 per cent butter-fat, and butter-fat is worth 28 cents per pound. What is the daily income from the herd?

2. I am making a handkerchief out of a piece of linen 10⅝ in. square. If I make a ½-in. hem all around it, how long and wide will it be when finished?

3. If Texas is 213.06 times as large as Rhode Island, and New York is 39.44 times as large as Rhode Island, then Texas is how many times as large as New York? Express to the nearest second decimal place.

4. According to the report of the Bureau of Census the numbers of persons engaged in the different groups of occupations in the United States in 1880 and 1910 were as follows:

Group	1880	1910
1	7,713,875	12,567,925
2	1,871,503	7,605,730
3	3,784,726	10,807,521
4	603,202	1,825,127
5	3,418,793	5,361,033

Find the total increase in the number of persons employed in the United States in 1910 over those employed in 1880.

5. A can of milk containing 40 quarts costs \$1.60. What percentage is gained by selling the milk for 6 cents a quart?

6. I bought a cask of molasses containing 84 gallons for \$28. Nine gallons having leaked out, at what price per gallon must I sell the remainder to gain \$4.25?

7. A farmer's wife bought 2.75 yards of table linen at \$0.87 a yard and 16 yards of flannel at \$0.55 a yard. She paid in butter at \$0.27 a pound. How many pounds of butter was she obliged to give?

8. A man and boy together spaded $\frac{9}{10}$ of a garden. If the man spaded twice as much as the boy, what part of the garden did each spade?

9. A contractor completed $\frac{2}{5}$ of a job in $12\frac{1}{2}$ days. How much longer should it take to finish the job?

10. In a certain state the cost of building a macadam road is shared by the town, county, and state. The state pays $\frac{1}{2}$, the county $\frac{1}{3}$, and the town the remainder. If the state pays \$1,200, what does the town pay?

On the basis of the preliminary testing, the first problem in the March test was supposed to be of equal difficulty with the first problem in the June test; the second problems in both tests were, likewise, supposed to be equal in difficulty; and similarly for the remaining problems. This equality has no particular interest in the present report, and the equality is obscured by the fact that the June test was given at the very end of the school year.

Tables III and IV are based upon Tables I and II, respectively, and show, for each problem and for each grade, the percentages of pupils who obtained correct answers. They also show, as a better expression of the difficulty of the problems, and, consequently, of the ability required for their solution, the equivalents of the percentages, in terms of that unit of variability of the curve of error known as the "Probable Error." It is, of course, a well-known fact that there is an illusion in percentage ratings, due to the fact that the distribution of ability does not take rectangular form, but, rather, that of a logarithmic curve of approximately "normal" type. Account of this distribution is taken when

TABLE III

PERCENTAGES OF CORRECT ANSWERS FOR EACH PROBLEM AND FOR EACH GRADE, WITH P.E. EQUIVALENTS
ARITHMETIC. MARCH TEST

Problem Numbers	Seventh Grade				Eighth Grade				Total	
	First Half		Second Half		First Half		Second Half			
	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median
1...	9.4	+1.95	11.2	+1.80	23.8	+1.06	39.9	+0.38	19.8	+1.26
2...	23.7	+1.06	31.0	+0.74	45.2	+0.18	61.7	−0.44	39.0	+0.41
3...	44.7	+0.20	54.9	−0.18	66.7	−0.64	76.4	−1.07	59.4	−0.35
4...	34.9	+0.58	42.8	+0.27	53.4	−0.13	72.5	−0.89	49.5	+0.02
5...	35.6	+0.55	49.0	+0.04	56.8	−0.25	70.2	−0.79	51.8	−0.07
6...	26.7	+0.92	35.4	+0.56	44.1	+0.22	54.3	−0.16	39.0	+0.41
7...	51.2	−0.04	62.5	−0.47	72.5	−0.89	78.9	−1.19	65.1	−0.58
8...	33.8	+0.62	43.3	+0.25	51.7	−0.06	69.1	−0.74	48.1	+0.07
9...	47.1	+0.11	51.9	−0.07	62.0	−0.45	65.8	−0.60	55.5	−0.21
10...	39.8	+0.38	50.1	−0.00	55.3	−0.20	72.8	−0.90	53.3	−0.12

TABLE IV

PERCENTAGES OF CORRECT ANSWERS FOR EACH PROBLEM AND FOR EACH GRADE, WITH P.E. EQUIVALENTS
ARITHMETIC. JUNE TEST

Problem Numbers	Seventh Grade				Eighth Grade				Total	
	First Half		Second Half		First Half		Second Half			
	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median	Percentage Correct	P.E. from Median
1...	20.8	+1.21	24.2	+1.04	30.4	+0.76	46.6	+0.13	29.3	+0.81
2...	10.5	+1.86	13.0	+1.67	16.6	+1.44	23.8	+1.06	15.2	+1.52
3...	55.2	−0.19	64.2	−0.54	68.7	−0.72	79.1	−1.20	66.0	−0.61
4...	65.5	−0.59	75.4	−1.02	78.0	−1.15	83.1	−1.42	74.9	−1.00
5...	67.8	−0.69	79.5	−1.22	85.3	−1.56	92.2	−2.10	80.3	−1.26
6...	30.0	+0.78	42.3	+0.29	45.6	+0.16	58.4	−0.32	43.1	+0.26
7...	51.0	−0.04	63.2	−0.50	71.4	−0.84	78.4	−1.17	65.6	−0.60
8...	38.6	+0.43	53.9	−0.15	54.4	−0.16	71.3	−0.83	53.5	−0.13
9...	30.2	+0.77	38.4	+0.44	47.1	+0.11	62.9	−0.49	43.4	+0.25
10...	36.0	+0.53	49.8	+0.01	41.1	+0.33	68.9	−0.73	49.1	+0.03

percentage values are thus converted into some unit of variability of the curve of error.[1]

The twenty problems listed in Tables I–IV, as has been stated, were given in March and in June, 1915, to typical schools in New York City. On the basis of the returns received from these schools, the figures given in Tables V and VI were made up. These figures refer to the scores of individuals. As measures of the ability of groups of children, these tables may prove useful. They are, however, only approximations.

TABLE V

DISTRIBUTION OF PUPILS ACCORDING TO THE NUMBER OF PROBLEMS ANSWERED CORRECTLY

ARITHMETIC. MARCH TEST

No. of Problems Correct	Grade VII[a]		Grade VII[b]		Grade VIII[a]		Grade VIII[b]		Grades VII[a] to VIII[b]	
	No.	Percentage	No.	Percentage	No.	Percentage	No.	Percentage	No.	Percentage
0.....	190	13.2	144	8.1	43	3.9	6	0.6	353	7.1
1.....	230	16.0	157	11.1	73	6.7	18	1.7	478	9.6
2.....	160	11.1	147	10.4	88	8.1	42	4.0	437	8.8
3.....	204	14.1	154	10.9	96	8.8	51	4.9	505	10.1
4.....	161	11.2	178	12.6	112	10.3	67	6.4	518	10.4
5.....	156	10.8	147	10.4	132	12.1	115	11.0	550	11.0
6.....	114	7.9	150	10.6	131	12.0	117	11.3	512	10.3
7.....	98	6.8	126	8.9	136	12.5	160	15.4	520	10.4
8.....	77	5.3	121	8.6	125	11.5	163	15.6	486	9.8
9.....	43	3.0	107	7.6	96	8.8	189	18.1	435	8.7
10.....	9	0.6	9	0.6	59	5.4	114	10.9	191	3.8
Total	1,442	.....	1,410	.....	1,091	.....	1,042	.....	4,985	.....
Median...	2.691	.....	4.747	.....	6.015	.....	7.656	.....	5.367	.....

The fact that the ten problems upon which each of these tables is based varied widely in point of difficulty makes conclusions as to individual abilities somewhat unreliable. Tables made up from material each part of which was of equal difficulty would be more reliable, but no such tables have ever been constructed, for the reason that no material meeting these conditions exists. Meanwhile, therefore, we shall be obliged to content ourselves with the usual method of approximation. With this caution

[1] For conversion tables see E. L. Thorndike, *Mental and Social Measurements*, 2d ed., p. 228; also B. R. Buckingham, *Spelling Ability, Its Measurement and Distribution*, p. 116.

in mind, Tables V and VI may be used as standards of attainment. Figs. 1–8 show, in graphic form, the frequencies of each rating as given in these tables.

TABLE VI

DISTRIBUTION OF PUPILS ACCORDING TO THE NUMBER OF PROBLEMS ANSWERED CORRECTLY

ARITHMETIC. JUNE TEST

No. of Problems Correct	Grade VII[1]		Grade VII[2]		Grade VIII[1]		Grade VIII[2]		Grades VII[1] to VIII[2]	
	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage
0.....	67	4.6	28	2.0	13	1.2	4	0.4	112	2.2
1.....	144	10.0	65	4.6	32	2.9	4	0.4	245	4.9
2.....	193	13.4	95	6.7	71	6.5	27	2.6	386	7.7
3.....	235	16.3	165	11.7	111	10.2	62	6.0	573	11.5
4.....	211	14.6	200	14.2	171	15.7	73	7.0	655	13.1
5.....	204	14.1	243	17.2	167	15.3	116	11.1	730	14.6
6.....	143	9.9	204	14.5	146	13.4	145	13.9	638	12.8
7.....	97	6.7	189	13.4	142	13.0	184	17.7	612	12.3
8.....	70	4.9	134	9.5	129	11.8	159	15.3	492	9.9
9.....	54	3.7	69	4.9	79	7.2	189	18.1	391	7.8
10.....	24	1.7	18	1.3	30	2.7	79	7.6	151	3.0
Total.....	1,442	.....	1,410	.....	1,091	.....	1,042	.....	4,985	.....
Median...	4.389	.....	5.626	.....	5.886	.....	7.489	.....	5.715	.....

Fig. 9 shows, for each grade, in the form of a scale, the facts with respect to the difficulty of the problems that were shown in the columns headed "P.E. from Median" in Tables III and IV, although the problems of the June test are not strictly comparable to those of the March test, on the basis of the returns received, for the reason that there is an increment of ability among school children during a three months' period. The two sets of problems are scaled on the same projection, but they are kept separate by showing, in Fig. 9, the numbers of the March problems above the scale line, and the numbers of the June problems below the scale line.

Fig. 9 also shows a general scale for the four grades combined; the point of reference is the median of Grade VII[1]. In order thus to refer the results of the testing in higher grades to the median of the lowest grade, it is necessary to know the intervals between the medians of the successive grades.

Tables VII and VIII show, for the March and June tests, the number of pupils in each grade who equaled or exceeded the score of the median

TABLE VII

AMOUNT AND PERCENTAGE OF OVERLAPPING WITH P.E. EQUIVALENTS
ARITHMETIC. MARCH TEST

		Grade VII^1	Grade VII^2	Grade VIII^1	Grade VIII^2
Grade VII^2	No.	.....	538	340	163
	Per cent	.....	37.3	25.3	11.3
	P.E.	.....	+0.48	+0.99	+1.80
Grade VII^3	No.	1038	.....	511	281
	Per cent	73.6	.....	36.2	19.9
	P.E.	−0.94	.....	+0.52	+1.25
Grade VIII^1	No.	915	708	.....	327
	Per cent	83.9	64.9	.....	30.0
	P.E.	−1.47	−0.57	.....	+0.78
Grade VIII^2	No.	989	875	742	.....
	Per cent	95.0	84.0	71.2	.....
	P.E.	−2.44	−1.48	−0.83	.....

Table reads: 538 pupils of Grade VII^1 equaled or exceeded the score of the median pupil of grade VII^2, which was 37.3 per cent of all pupils of Grade VII^1. The equivalent of this percentage is 0.48 P.E., etc.

TABLE VIII

AMOUNT AND PERCENTAGE OF OVERLAPPING WITH P.E. EQUIVALENTS
ARITHMETIC. JUNE TEST

		Grade VII^1	Grade VII^2	Grade VIII^1	Grade VIII^2
Grade VII^2	No.	.....	465	412	198
	Per cent	.....	32.2	28.6	13.7
	P.E.	.....	+0.69	+0.84	+1.62
Grade VII^3	No.	980	.....	642	318
	Per cent	69.5	.....	45.5	22.6
	P.E.	−0.76	.....	+0.17	+1.12
Grade VIII^1	No.	789	589	.....	311
	Per cent	73.1	54.0	.....	28.5
	P.E.	−0.91	−0.15	.....	+0.84
Grade VIII^2	No.	917	800	770	.....
	Per cent	88.1	76.8	73.9	.....
	P.E.	−1.75	−1.09	−0.95	.....

Table reads: 465 pupils of Grade VII^2 equaled or exceeded the score of the median pupil of Grade VII^2, which was 32.2 per cent of all pupils of Grade VII^1. The equivalent of this percentag is 0.69 P.E., etc.

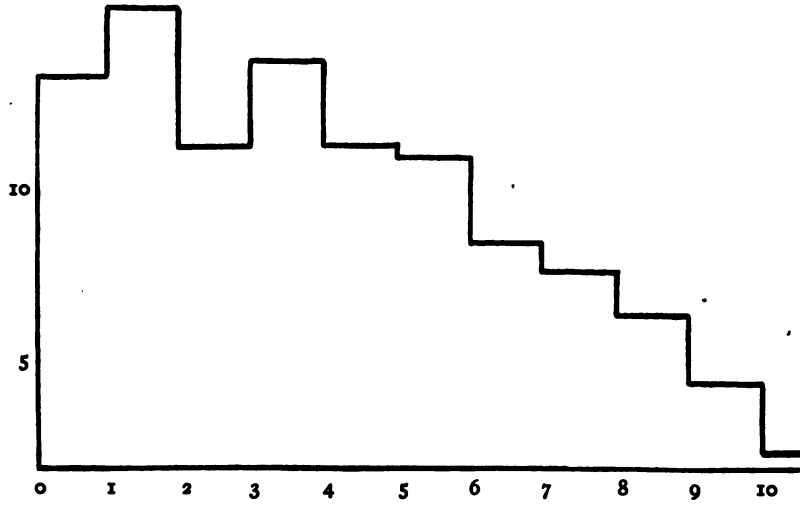

FIG. 1

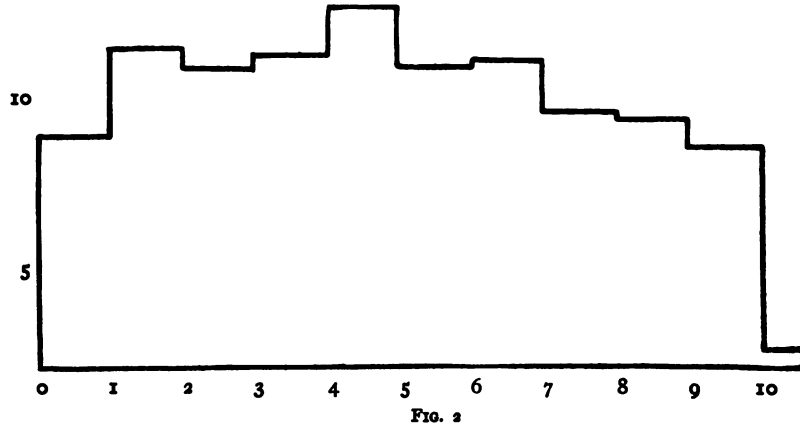

FIG. 2

FIGS. 1, 2, 3, AND 4.—Frequency of each rating (of problems correct) in Gr
for problems answered correctly. The vertical scale is for the percentage of chil
Grade 7^2; 1,091 for Grade 8^1; and 1,042 for Grade 8^2.

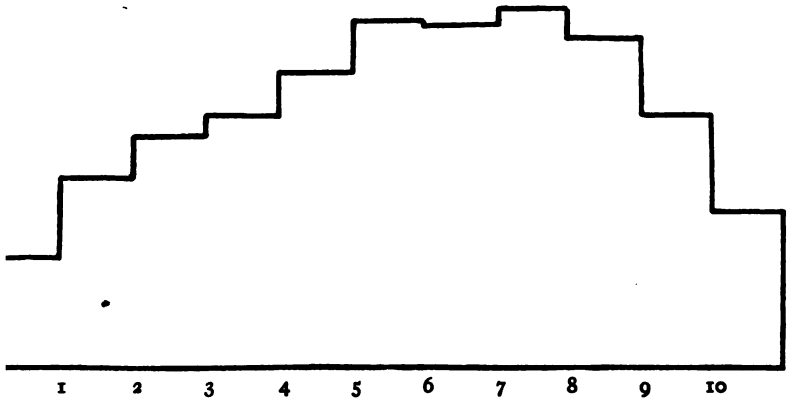

FIG. 3

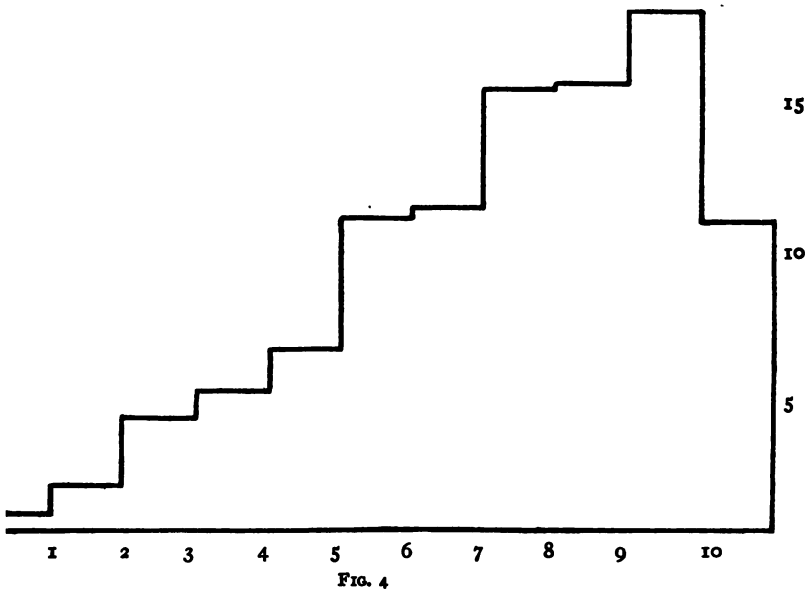

FIG. 4

7^2, 8^1, and 8^2, respectively. March test. (See Table V.) The horizontal scale is o obtained each correct number of answers. N = 1,442 for Grade 7^1; 1,410 for

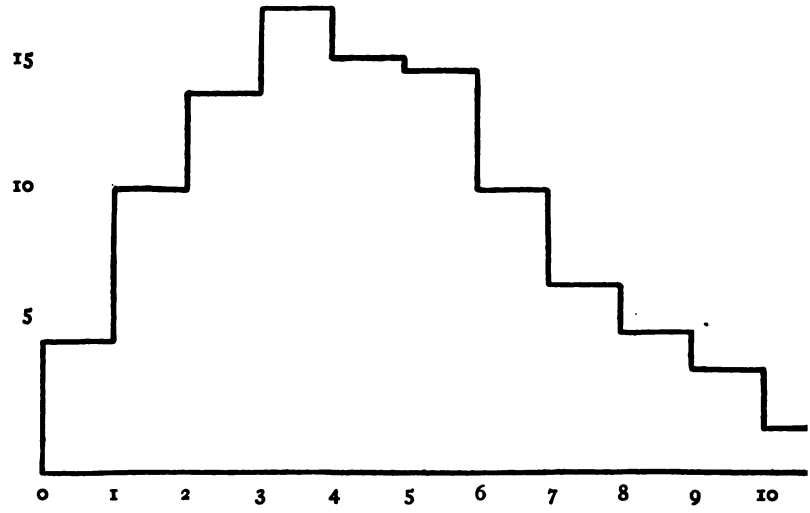

FIG. 5

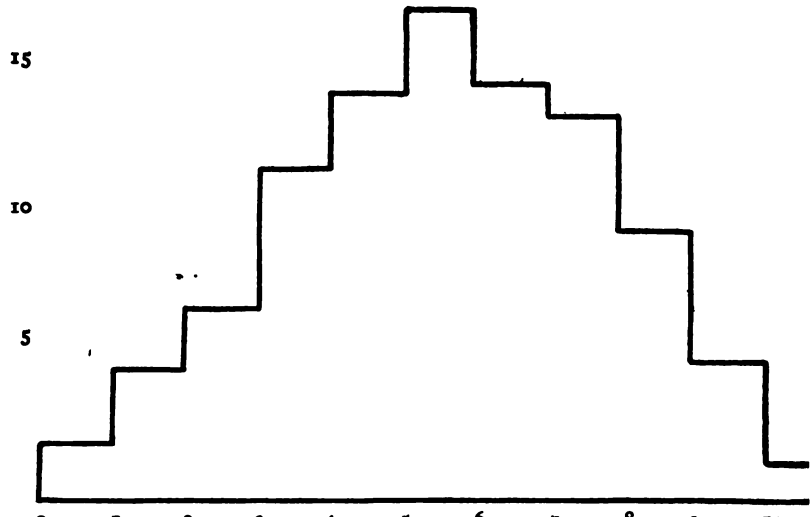

FIG. 6

FIGS. 5, 6, 7, AND 8.—Frequency of each rating (of problems correct) in Grad for problems answered correctly. The vertical scale is for the percentage of childr Grade 7^2; 1,091 for Grade 8^1; and 1,042 for Grade 8^2.

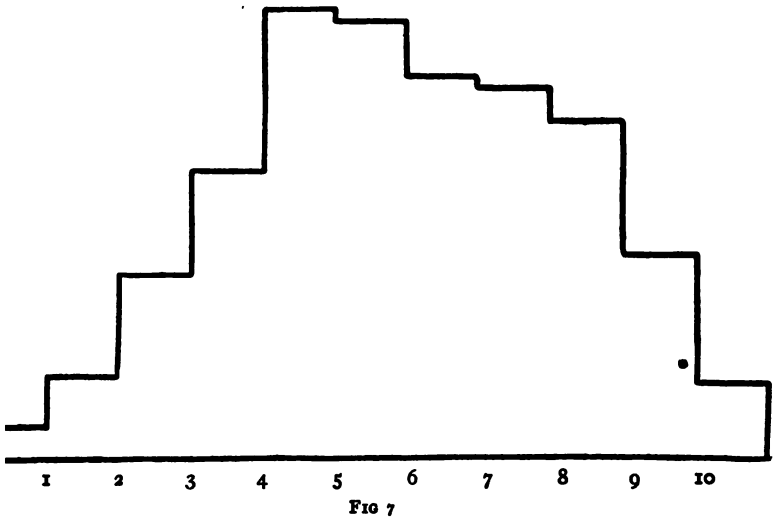

FIG 7

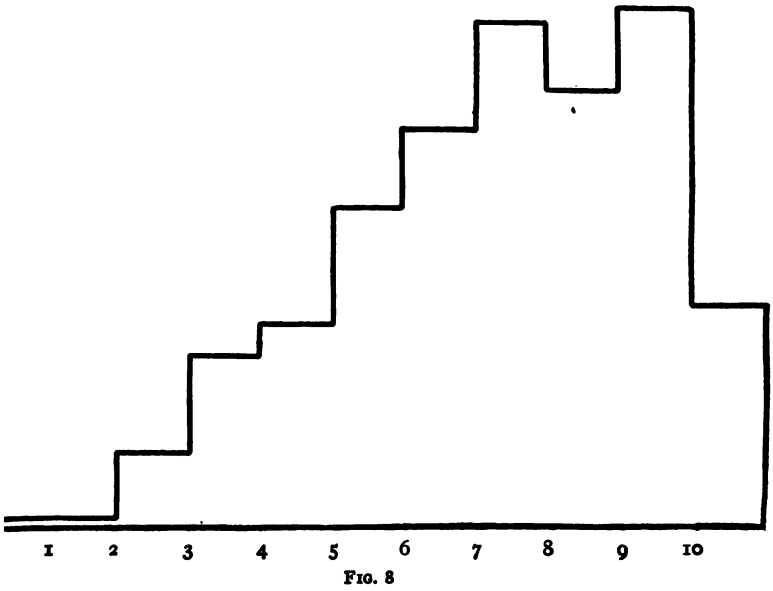

FIG. 8

^{1}, 8^{1}, and 8^{2}, respectively. June test. (See Table VI.) The horizontal scale is obtained each correct number of answers. N = 1,442 for Grade 7^{1}; 1,410 for

pupil of each of the other grades. They also show the percentages and P.E. values corresponding to these numbers. The P.E. values are the intervals between the grade medians. These tables are constructed upon the assumption of a normal distribution of ability in all grades, and upon the further assumption that the variability in any one grade is equal to the variability in each of the other grades.

Obviously, we have several expressions for the same relationship; for instance, in Table VIII, the distance between the median of Grade VII^1 and the median of Grade VII^2 is (column 4) 0.69. In the same table, the same distance measured in the opposite direction is 0.76. Two similar values for the same distance are shown in Table VII; and besides these four measures, a number of others may be derived. Using, however, only direct statements of the relationship between consecutive medians, we have, in each case, four quantities. The averages of these, being taken, give the following results:

Median of Grade VII^1 to median of Grade VII^3 = 0.72 P.E.
" " " VII^2 " " " " VIII^1 = 0.37 P.E.
" " " VIII^1 " " " " VIII^2 = 0.85 P.E.

To obtain the general scale shown in Fig. 9, all that is necessary to do now is to add to the P.E. values of Tables III and IV, for grades higher than VII^1, the interval at which the medians of these grades stand above the median of Grade VII^1. By so doing, three values in addition to the one for Grade VII^1 will be found, and the average of these four may be taken as the best position at which to "place" the problem in question.

Table IX gives the distance at which each problem stands above the median of Grade VII^1 when computed on the basis just described. The general scale in Fig. 9 is the graphic representation of this table.

It is clear that the scales derived in this paper are very meager, and, as was said in the beginning, this report is merely preliminary and suggestive. A far greater number of problems in arithmetic should be used for the purpose of constructing a more complete scale. In fact, 120 such problems are now being worked up with this end in view. Material is likewise in hand for a large number of questions in geography, history, and grammar, which will be scaled in the same way.

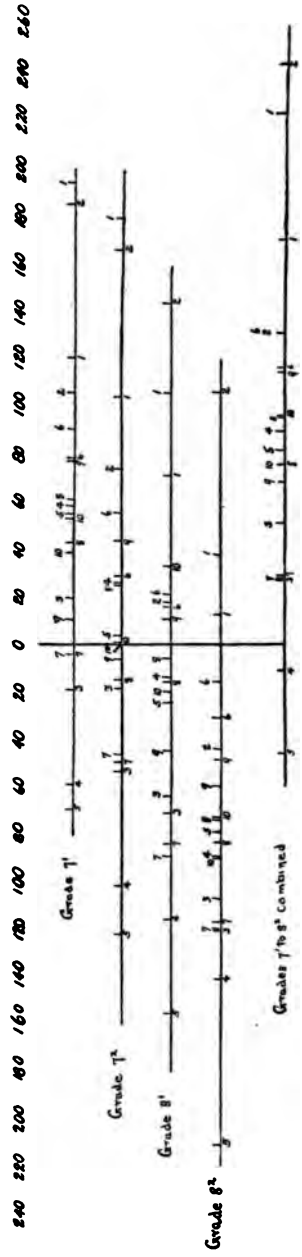

FIG. 9

FIG. 9.—Grade and General Scales. Figures above the scale lines refer to the March Test, those below the scale lines to the June Test.

Any superintendents or principals who are willing to give tests in these subjects are invited to communicate with the writer of this chapter.

TABLE IX

AVERAGE POSITION OF PROBLEMS, EXPRESSED AS DISTANCES FROM THE MEDIAN OF GRADE VII AND IN UNITS OF P.E.

Problem	March	June
1	2.24	1.72
2	1.32	2.45
3	0.52	0.28
4	0.90	−0.11
5	0.83	−0.46
6	1.32	1.17
7	0.29	0.30
8	0.96	0.76
9	0.69	1.15
10	0.76	0.97

CHAPTER III

SCORE CARD FOR CITY SCHOOL BUILDINGS

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The score card which is printed herewith has been developed as a part of the advanced work in educational administration under the direction of the author of this article, with five different groups of graduate students, through two academic years and one summer session.[1] The idea of a score card has been common over a considerable period of years, especially in the work of agricultural colleges. There is a manifest advantage in the score card in that it fixes attention upon all of those qualities or elements which go to make up the perfect whole desired. Individuals in judging school buildings not infrequently think mainly in terms of two or three elements which seem to them to be of primary importance, and often neglect other parts of the building which are, when one stops to consider them, of equal value. In making the score card, it has been necessary first of all to include as nearly as possible all those details which go to make up the perfect school building. It was, of course, desirable, in so far as it was possible, to include under a few main heads all the subordinate factors. It was only after a very considerable amount of experimentation that the heads "Site," "Building," "Service Systems," "Classrooms," and "Special Rooms" were decided upon.

After organizing the score card in terms of the large and the subordinate heads, the next step was, of course, to assign to each main and each subordinate head the proper weight out of a total of a thousand points which was allowed as a perfect score. The method employed was

[1] Special acknowledgment is due to Messrs. L. H. King, B. W. Loomis, and A. Dushkin, who were constituted as the first committee to draft a score card for school buildings, and whose work was used as a basis for discussion in the subsequent development of the form which is here printed. The author is indebted to Dr. M. R. Trabue for the statistical calculations necessary to determine the weights to be assigned to each of the several items.

to ask experienced superintendents and principals of schools taking work in educational administration, which involved a considerable knowledge of statistics, to assign to each element the weight which they thought should be attached. The five large heads were scored first, next the several main subdivisions under each large head, and finally the elements under the last-named divisions. More than two hundred students participated in this part of the work. From the ratings assigned by the last group of a hundred students working upon the score card, after studying the results which had already been secured by the former groups, medians were calculated, first, for the large heads, and then for each of the subordinate heads. The medians were calculated only to the nearest five points on the scale. This means that the score card as it appears represents the combined judgment of the scorers to within two and one-half points. In many cases, of course, the median fell on five or some multiple of five, in which case the score given corresponds exactly to the median found.

The method employed in determining the weight to be assigned to each element appearing on the score card needs no particular defense, since the value of any particular part or element in the construction of the building is, after all, a matter of judgment. The median judgment derived from the scores allowed by a large group of those competent to judge of the worth of the several elements is the best single measure which can be found.

In order to use the score card, one should be familiar with the problems involved in schoolhouse construction. To that end, there appears at the end of the score card a bibliography. It would be well, in training people to use the score card, to have them thoroughly conversant especially with the more important authorities on the subject of school hygiene and school architecture. After such study, visits to buildings, under the guidance of some competent student of these problems, would add greatly in training persons to use the card. The card is given first in a very brief and highly condensed form, which could be used only by those entirely familiar with the longer form and with the meaning of each of the headings which is there listed. As a matter of practice, it will be best first to use the longer form of the score card, and, only, after considerable facility has been acquired, to drop the longer form in favor of the shorter summary. For one familiar with school buildings and with the score card, much would be gained by checking over blueprints

and specifications in the light of the score card before beginning to construct the building. Here again the value is in large measure to be found in the fact that each of the more important items will be brought to the attention of the one who seeks to criticize the plans and specifications, and their relative importance will at least in some measure be indicated.

It will be found particularly worth while to score old buildings, in order to call attention to the necessity for reconstruction which is always to be found in a city in which buildings have been in use over a considerable number of years. As one studies the problem of school buildings in the United States, he is impressed by the accidental or occasional repair or reconstruction which is provided. A careful study and scoring of these buildings will often indicate common deficiencies of very great importance which should receive immediate attention, and others which are of relatively less significance which may be postponed for a time. In the same school system it may be found as well that one building is so remarkably more deficient than another that it is manifestly good public policy to spend whatever money is available in reconstructing the buildings which scores lowest before undertaking the work which may not be nearly as important in other buildings.

In the case of scoring school buildings, as with any other instrument of measurement, the result should suggest problems, and in some measure indicate the direction in which reforms are to be brought about. Any person using the score card should supplement the mere scoring of the several items with a report upon any notable deficiency which renders the building unfit for use. It is entirely conceivable that a building on most counts might stand high, but in some one particular, say with respect to fire protection or sanitation, might rate as entirely unsatisfactory. In this case the notation, after the building was scored, would call attention to the fact that measures should be taken immediately to remedy particular defects, in which case the building would, possibly with a minimum of expense, be brought up to a very high standard of excellency.

The writer will be very glad to receive, from anyone who may use the score card, criticisms or suggestions for its improvement. It will be particularly helpful to receive reports of the use of the score card, showing to what degree two or more individuals scoring the same building arrive at the same result.

SCORE CARD FOR SCHOOL BUILDINGS AND EQUIPMENT FOR CITY ELEMENTARY AND HIGH SCHOOLS

City..... Building.....
Principal..... Date.....
Enrolment: Boys..... Girls..... Total.....
Average Daily Attendance: Boys.....Girls..... Total.....
Number of Rooms..... Approximate Cost.....
Scorer.....

INSTRUCTIONS

1. Abbreviation: S—standard.
2. Basis for scoring—1,000 points.
3. In scoring classrooms, stairways, entrances, fire escapes, and the like, score each separately and insert the average for the final score.
4. It will be worth while to use this card in checking up blueprints of prospective buildings. To do this will require a complete set of specifications with the blueprints, also a copy of state laws and city ordinances.

SHORT FORM OF SCORE CARD

I. SITE..... (125)
- A. Location..... (55)
  - 1. Accessibility (25) 2. Environment (30)
- B. Drainage..... (30)
  - 1. Elevation (20) 2. Nature of Soil (10)
- C. Size and Form..... (40)

II. BUILDING..... (165)
- A. Location..... (25)
  - 1. Orientation (15) 2. Position on Site (10)
- B. External Structure..... (60)
  - 1. Type (5) 2. Material (10) 3. Height (5)
  - 4. Roof (5) 5. Entrances (10)
  - 6. Aesthetic Balance (10) 7. Condition (15)
- C. Internal Structure..... (80)
  - 1. Stairways (35) 2. Corridors (25) 3. Basement (15)
  - 4. Attic (5)

III. SERVICE SYSTEMS..... (280)
- A. Heating and Ventilation System..... (70)
  - 1. Kind (20) 2. Installation (10) 3. Air Supply (25)
  - 4. Distribution (15)
- B. Fire Protection System..... (65)
  - 1. Apparatus (10) 2. Fireproofness (20) 3. Escapes (20)
  - 4. Electric Wiring (5) 5. Fire Doors (10)

C. Cleaning System ..... (20)
D. Artificial Lighting System ..... (20)
E. Electric Service Systems ..... (15)
1. Clock (5) 2. Bell (5) 3. Telephone (5)
F. Water Supply System ..... (30)
G. Toilet System ..... (50)
1. Distribution (10) 2. Fixtures (10) 3. Adequacy (10)
4. Seclusion (5) 5. Sanitation (15)
H. Mechanical Service Systems ..... (10)
1. Elevators (5) 2. Book-Lifts (2) 3. Waste-Chutes (3)

IV. Classrooms ..... (290)
A. Location and Connections ..... (35)
B. Construction and Finish ..... (90)
1. Size (25) 2. Shape (15) 3. Floors (10)
4. Walls (10) 5. Doors (5) 6. Closets (5)
7. Blackboards (10) 8. Color-Scheme (10)
C. Illumination ..... (85)
1. Glass Area (45) 2. Windows (30) 3. Shades (10)
D. Cloakrooms and Wardrobes ..... (25)
E. Equipment ..... (55)
1. Seats and Desks (40) 2. Teacher's Desk (10)
3. Bulletin Boards (5)

V. Special Rooms ..... (140)
A. Large Rooms for General Use ..... (65)
1. Playroom (10) 2. Auditorium (15) 3. Study-Hall (5)
4. Library (10) 5. Gymnasium (15) 6. Lunchroom (10)
B. Rooms for School Officials ..... (35)
1. Offices (10) 2. Teachers' Room (10) 3. Nurses' Room (10)
4. Janitor's Room (5)
C. Other Special-Service Rooms ..... (40)
1. Laboratories (20) 2. Lecture-Rooms (10) 3. Storerooms (5)
4. Studios (5)

DETAILED SCORE CARD FOR CITY SCHOOL BUILDINGS

I. Site

A. *Location:*

1. Accessibility—centrality (present and future), car lines, streets.
2. Environment:
   a) Physical—gardens, trees, shrubbery, buildings, hills.
   (S—Skyline should not have an angle of more than 30 degrees from base of building.)
   b) Social—density of settlement, composition, moral influences.
   c) Protection—freedom from noise, dust, danger, malodors.

B. *Drainage:*

1. Elevation, slope. (S—Grounds should slope away from building and should not exceed 1 in. for every 3 ft.)
2. Nature of soil—residual or artificial, kind, texture, aeration, hydration, surface material.

C. *Size and Form:*

Should be large enough and of good shape to allow for proper placing of buildings, for 30 sq. ft. of playground per child, and for school garden.

II. Building

A. *Location:*

1. Orientation—light, exposure. (S—Southeast, east, southwest, west, and south in order.)
2. Position on site as regards appearance and economy of playgrounds.

B. *External Structure:*

1. Type—rectangle, square, inner court, T, H, E, U.
2. Material. (S—Brick or stone.)
3. Height—number of stories. (S—Two stories above basement.)
4. Roof—type and material. (S—Flat, waterproof, suitable for playground, proper slope for drainage.)
5. Entrances:
   a) Number, location width. (S—At least two, near stair landings, 11–13 ft. wide.)
   b) Steps—number, protection from the elements. (S—As few as possible, unexposed.)
   c) Vestibules—size, lighting. (S—11–13 ft. wide, double-swing glass doors, and waterproof floors.)
   d) Doors—kind, opening, springs, checks, stops. (S—3½ ft.×8 ft., opening outward with panic bolts.)
6. Aesthetic balance. (S—Simplicity and utility.)
7. Condition. (S—Should be in good repair.)

C. *Internal Structure:*

1. Stairways.
   a) Construction—kind (box, open, winding), material, tread and riser, nosing, width, landing, banister (number, kind, size, stability), soundproofness. (S—Tread, 11–13 in.; riser, 7 in.; width, 5 ft.; metal banister, 1½ in. dia., at least two for each stairway, firmly attached.)
   b) Number and location—proximity to exits. (S—At least two, landings near exits.)
   c) Lighting—natural and artificial. (S—Should be well lighted.)
   d) Sanitation—coves, corners, ledges. (S—Should have sanitary coves and be free from dust-catchers.)

2. Corridors.
   a) Location.
   b) Construction—material, width, door arrangement, finish (chair rail, picture mold, dado). (S—Width 11–13 ft.)
   c) Obstructions—lockers, cases, pedestals. (S—These should not obstruct easy passage.)
3. Basement.
   a) Depth below grade, dampness, areas. (S—Depth, 3 ft.; floor and walls waterproof.)
   b) Boiler-room, accessibility to fuel-room, exits, ash-lifts.
   c) Fuel-room, size, construction, chute.
4. Attic, waterproof, heatproof, floor.

III. Service Systems

Note.—Defects in any service system should be checked against the system, wherever found.

A. *Heating and Ventilating System:*
   1. Kind of system—direct, direct-indirect, gravity, plenum, plenum-exhaust.
   2. Installation—piping, workmanship, noise, control. (S—All piping should be insulated.)
   3. Air supply—source, amount, humidification, ducts. (S—From the top of the building; humidity 40–60 per cent; 2,000 cu. ft. per hour per pupil, should not enter with a velocity greater than 6 ft. per second.)
   4. Distribution—size, arrangement, kind of ducts, pipes, and radiators. (S—Single ducts for each room; inlets 8–9 ft. above floor, outlets near floor.)

B. *Fire Protection System:*
   1. Apparatus—fire hose, extinguishers, water pressure, fire alarms. (S—Adequate supply on each floor; fire alarms easily accessible, automatic in boiler-room, connected with city fire department.)
   2. Fireproofness:
      a) Building as a whole—rating of underwriters.
      b) Stairways. (S—Encased fireproof stair-wells.)
      c) Boiler- and fuel-rooms. (S—Separate fireproof rooms.)
   3. Fire escapes—number, location, kind, protection, number of exits. (S—In non-fireproof buildings there should be at least two fire escapes.)
   4. Electrical work—nature and place of intake, insulation, number and kind of outlets, location of switches, meter, cut-out, cabinets. (S—Should be installed according to rules of underwriters.)
   5. Fire doors—kind, location, operation. (S—Automatically closing.)

C. *Cleaning System:* Kind, installation, efficiency. (S—Vacuum system.)

D. *Artificial Lighting System:* Kind, amount, distribution, number, and location of switches, outlets for lanterns, etc.

E. *Electric Service Systems:*
   1. Clocks.
   2. Bells and gongs.
   3. Telephones—number and location. (S—At least one on each floor.)

F. *Water Supply System:* Drinking-fountains, baths, lavatories, janitor's supply (on each floor). Installation and sanitation.

G. *Toilet System:*
   1. Distribution—location, accessibility. (S—Most on first floor, others distributed.)
   2. Fixtures—seats, urinals, washbowls, sinks, towel and paper holders—size, kind, durability, and arrangement.
   3. Adequacy—number. (S—1 seat for each 15 girls, 1 seat for each 25 boys, 1 urinal stall for each 10 boys.)
   4. Seclusion—soundproofness, doors.
   5. Sanitation—finish, material, workmanship, lighting, ventilating. (S—Material—not absorbent, non-corrosive.)

H. *Mechanical Service Systems:*
   1. Elevators (for buildings of more than four stories)—location, fireproofness, adequacy.
   2. Book-lifts.
   3. Waste-chutes—kind, location, size. (S—Fireproof, outlets closing automatically.)

IV. Classrooms

A. *Location and Connections* (to exit, drinking-fountains, toilet). Deduct for baserooms and those above fourth floor without elevators.

B. *Construction and Finish:*
   1. Size. (S—Per pupil 15 sq. ft. floor space and 200 cu. ft. air space.)
   2. Shape—classroom 24×30×12 ft.
   3. Floors—material, condition (cracks, checks, splinters, loose boards, projecting ends), width of boards, soundproofness, cove, baseboard, surface, finish. Stone, tile, cement, and other composition floors are bad for class- or study-rooms. (S—Should be battleship-linoleum, or hard wood, durable, well joined, and not dust-retaining.)
   4. Walls, ceiling—plastering, finish, texture, condition, picture mold, chair rail, kind and condition of dado. (S—Hard, smooth, non-glass plaster, with cement plaster for dado, avoiding grooves and ledges.)
   5. Doors—how opened, size, kind, lock, threshold, transom, number of exits. (S—Doors without thresholds and transoms.)
   6. Closets and bookcases—location, size, convenience.
   7. Blackboards—kind, length, width, color, chalk rail, height from floor, surface, quality, condition, trim. (S—Slate, full black, on front and side of room, 36–42 in. wide, height of chalk rail, grades I–II, 24 in.; III–IV, 26 in.; V–VI, 28 in.; VII–VIII, 30 in.; high school, 32–36 in.)

8. Color-scheme—woodwork, dado, walls, ceiling, furniture, shades, finish, fixtures. (S—Neutral color, buff or green; dado slightly darker than walls, white or cream ceiling; woodwork, furniture, and shades to harmonize in tone; dull, smooth finish.)

C. *Illumination:*
1. Glass area—$\frac{1}{5}$ to $\frac{1}{4}$ area of floor.
2. Windows—size of mullions, nearness to ceiling, height of sill, kind of glass, distance of front window from front wall, orientation, shape. (S—From pupils' left, unilateral, grouped, symmetrical, as near ceiling as possible, $3\frac{1}{2}$ to 4 ft. from floor, plain glass, mullions not over 12 in. wide. Front windows should not come within 5 ft. of front wall; easterly exposure best; rectangular in shape.)
3. Shades—kind, material, hanging, adjustment, condition. (S—Adjustable from center.)

D. *Cloakroom, Wardrobes:* Location, size, convenience, ventilation, finish. (S—Ample ventilation and accommodation.)

E. *Equipment:*
1. Seats and desks—kind, number. (S—Adjustable-movable or adjustable; not over 42 in number.)
2. Teacher's desk. (S—No platform.)
3. Bulletin boards.

V. Special Rooms

A. *Large Room for General Use:*
1. Playroom—location, size, accessibility, adaptability, finish. (S—Per pupil 15 sq. ft. floor space and 200 cu. ft. of air space.)
2. Auditorium:
   a) Location, accessibility. (S—Should be on first floor.)
   b) Construction—size, height, seating capacity, floor, acoustics, exits, obstructions, gallery (kind, seating capacity, location), light and nature of stage, finish, ornamentation. (S—For 80 ft. length on flat floor, stage should be 3 ft. 8 in. high; on dish floor, 3 ft.)
   c) Auxiliaries—dressing-rooms, curtain, setting, seats (kind, arrangement).
3. Study-hall—location, size, accessibility (especially to library), adaptability, finish.
4. Library—location, size, accessibility, form and arrangement of stacks.
5. Gymnasium:
   a) Location—accessibility, segregation of sexes.
   b) Construction—size, floor, track, gallery, soundproofness, finish. (S—Height 22–25 ft. Length and width should relate as 3 to 2.)
   c) Auxiliaries—lockers, showers, dressing-rooms (number, kind, location, convenience, condition.)
6. Lunchroom—location, accessibility, size, adaptability, arrangement, finish, sanitation.

B. *Rooms for School Officials:*
   1. Offices—location, size, adaptability, finish; waiting-room (ditto).
   2. Teachers' room—location, size, toilet facilities, equipment, finish. (S—Equipped with chairs, couch, gas or electric plate.)
   3. Nurses' room—location, size, equipment and toilet facilities (including bath) adaptability, sanitation, finish.
   4. Janitor's room—location, size, convenience.

C. *Other Special-Service Rooms:*
   1. Laboratories:
      NOTE.—Include all facilities for chemistry, physics, biology, physiography, commercial work, household and industrial arts.
      a) Kind, location, size, adaptability. (S—Depends on number of pupils to be accommodated. A room 30×40 ft. will accommodate 25 pupils.)
      b) Construction—plumbing, storerooms, cabinets, finish.
   2. Lecture-room—location, size, seating capacity, plumbing facilities, accessibility, fixed furniture (number, kind, arrangement).
   3. Supply- and storerooms—location, size, adaptability.
   4. Studios—kind, location, size, and adaptability.
      NOTE.—Include drawing-, art,- and music-rooms.

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CHAPTER IV

COMPLETION TESTS FOR PUBLIC-SCHOOL USE

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Many of the tests upon which psychologists depend for their knowledge of an individual's mental characteristics are of such a nature that it is almost impossible to make extended use of them in the schoolroom. There are other very reliable psychological tests, however, which may be adapted to schoolroom use with comparatively few changes. One of these is the completion test, which psychologists have come to regard as an unusually good test of ability to think about words and language forms. In view of the fact that so much of the child's school work is dependent upon his ability to read and interpret printed words, it has seemed worth while to the writer to make such changes in the form of the completion test as will make it available for general use in schools.[1]

The scale shown below will serve as an example of the proposed new completion-test forms. It is believed that these new forms will be found very helpful to school officers in measuring the abilities of children and in classifying them accordingly.

The foregoing form is designed to meet the two or three most serious obstacles which heretofore have confronted the school officer who wished to employ the completion test in his school system. In the first place, the forms commonly used by the psychologists cannot be employed in the middle and lower grades of the elementary school because they are too difficult. Ebbinghaus, who was the first to employ the completion-test method, used mutilated paragraphs. In this respect he has been followed very closely by later investigators, and in almost every instance the incomplete paragraphs have been too difficult for practical use with elementary school pupils. I have attempted, in preparing forms for school children, to use the sentence, rather than the paragraph,

[1] M. R. Trabue, "Completion-Test Language Scales," *Teachers College Contributions to Education*, No. 77, New York, 1915.

as the unit of thought. I have found it possible to begin a test with sentences so simple that a large majority of the second-grade pupils are able to complete them correctly, and to finish the test with sentences so difficult that only a small percentage of the Freshmen in college complete them.

Write only one word on each blank
Time Limit: Seven minutes

Name..... .....

TRABUE LANGUAGE SCALE B

1. We like good boys ..... girls.
6. The ..... is barking at the cat.
8. The stars and the ..... will shine tonight.
22. Time ..... often more valuable ..... money.
23. The poor baby ..... as if it were ..... sick.
31. She ..... if she will.
35. Brothers and sisters ..... always ..... to help ..... other and should ..... quarrel.
38. ..... weather usually ..... a good effect ..... one's spirits.
48. It is very annoying to .... tooth-ache, ... often comes at the most ..... time imaginable.
54. To ..... friends is always ..... the ..... it takes.

A second difficulty with previous completion-test forms arises from the fact that we do not know the relative values of the various commonly used paragraphs, which makes it practically impossible to measure progress from year to year or from grade to grade. Professor Whipple emphasizes this point, as follows: "Since the elision of a single letter may, in some circumstances, very considerably increase the difficulty of the test, it follows that, without extensive preliminary trials, it is well-nigh impossible to prepare a series of texts of equivalent difficulty, or to insure that the several sections within a given text present equivalent difficulty."[1]

This objection has been met by actually trying the incomplete sentences upon thousands of public-school children and discovering from the results just how difficult each sentence is for each class of children, and for all children together. From the results thus obtained,

[1] G. M. Whipple, *Manual of Mental and Physical Tests*, Part II (1915), p. 284.

four approximately equal scales have been derived (Scale B, shown above, being one of the four), each scale consisting of ten sentences, which are arranged in the order of their difficulty from simple to hard. By measuring ability at the beginning of a year with one scale and then at the beginning of the next year with an equivalent scale, it is possible by subtracting the first result from the second to determine the amount of change effected in a class or in a child during a year.

A third difficulty with the paragraph form of the completion test is found in the scoring. Ebbinghaus scored according to the number of syllables correctly supplied, but this method is inadequate, for some syllables are ten times as hard to supply as others. Later investigators have estimated the quality of the completed paragraphs as wholes, giving 100 per cent for a perfectly completed paragraph, 50 per cent "if the inserted words make a well-connected story, but related in only a moderate degree to the thought that should have been given," and no credit at all for words which are "purely literary invention, having no connection with the thought given by the printed words."

It will readily be seen that very careful consideration and judgment are required if one is to assign accurate and comparable scores in the foregoing manner. Even trained psychologists have difficulty in agreeing just how much a given completion is worth. Teachers and school administrators are usually too busy with other school problems to spend much time in such tiresome mental labor as is required to assign scores to partially completed paragraphs.

After making an attempt to distinguish six grades of quality (5–4–3–2–1–0) in the completion of a sentence,[1] the writer found that practically nothing was lost by simplifying the scoring still further, giving 2 points credit for each perfectly completed sentence, 1 point for each sentence completed with only a slight imperfection, and 0 for any sentence omitted or imperfectly completed. It is infinitely easier and quicker to say that a sentence is "right," or that it is almost "right," than it is to decide that a partially completed paragraph is worth 78 per cent of a perfectly completed paragraph. The writer has also published in the appendix of his report the detailed scheme by which each individual sentence was scored, in order that teachers or administrators who do not wish to be

[1] J. L. Stenquist, E. L. Thorndike, and M. R. Trabue, "The Intellectual Status of Children Who Are Public Charges," *Archives of Psychology*, No. 33, September, 1915, pp. 13–19.

bothered with the making of judgments as to whether a sentence is right or wrong may have before them very objectively just what has been called "right" and what has been called "wrong."

The writer is rather firmly convinced that ability to perform mental tasks can be measured more adequately by a graded series of performances to be done in a given time than by any other scheme. The measurement of physical ability to lift weights at arm's length may be taken as an analogy. If we had a series of ten weights, ranging from 20 to 200 pounds by steps of 20 pounds between consecutive weights, as represented in Fig. 1, we might measure a boy's ability by having him begin at the lightest of the series and at arm's length lift in their order to the level of his shoulder as many of the weights as possible. In order to make the analogy with Scale B complete, we should have to give 2

FIG. 1.—Representing a series of graduated weights.

points credit for each weight lifted to a level with his shoulders, and 1 point for each weight which was lifted "almost but not quite" to the shoulder level within a time-limit of seven minutes.

With the older completion-test forms the analogous measurement would be as follows: give the individual the 200-pound weight and see how nearly to the shoulder level he can raise it in ten minutes. It is clear at once that a test arranged on such a plan could be used for only a short fraction of the total range of ability, and that scores assigned by different individuals for the same quality of performance would vary considerably.

With certain commonly used tests in arithmetic the analogous measurement would be somewhat as follows: give the boy a large number of 100-pound weights and see how many of them he can at arm's length lift to shoulder level in four minutes. It is evident at once that a large amount of ability must be present before such a test can begin to measure, and that speed is practically the only element of ability measured. Since speed is desirable, however, it is highly worth while to measure it, although we must be careful not to take a measurement of speed as a sufficient index of ability.

In arranging the language scales, the writer has assumed that older children will not only be able to do the same tasks more rapidly and more perfectly than younger children, but that the older children will also be able to accomplish perfectly tasks which the younger children could not begin to do. The results from twelve or thirteen thousand children, upon whom these sentences have been tried, seem to support this assumption in every respect.

The unit of difficulty used in constructing Language Scales B, C, D, and E is the P.E., or median deviation from the median of a school-grade distribution of ability, assuming the curve of distribution for ability in any given grade to be "normal" in shape and equivalent in range to the range of any other grade distribution. The reasons for making these assumptions and using this measure of the variability of a

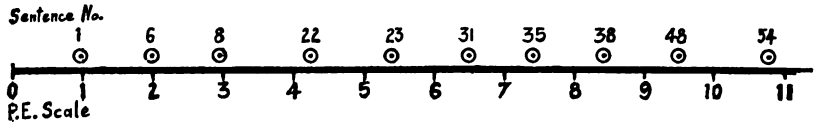

FIG. 2.—Linear projection of Language Scale B.

grade as the unit need not be discussed here. It is worth while to remember, however, that if we take any two groups, selected by the same or by equally capable judges as representing two different degrees of the same sort of ability, these two groups are very likely to be distributed "normally" in each case and the variability of one group will probably be very nearly equal to the variability of the other. In other words, approximately as many errors of judgment are made in selecting one group as in selecting the other, and in each group approximately as many are overestimated as are underestimated, errors in either direction being much more frequently small than large. In brief, the P.E. is a convenient unit which has approximately the same value in every grade and may therefore be used to measure the distance between grades and the difficulty of tests for all grades.

On a P.E. scale above an arbitrary zero point, the location of each sentence of Language Scale B is as represented in Fig. 2. It will be observed that the intervals between sentences are not exactly 1 P.E. in each case, but for practical purposes they are near enough. The improvement made by a person who was at first able to complete only two sentences but is now able to complete four is at least in a very real sense

equal to the improvement made by the person who was at first able to complete only seven sentences but is now able to complete nine.

As yet the writer has not had time to use the new scales very extensively in their present form, although the sentences of which they are composed have been thoroughly tested in other combinations of sentences. Language Scale A,[1] which is so poorly graded as not to be worthy of the name "scale," has nevertheless revealed some of the possible values of the completion test in school procedure.

Scale A was composed of 24 sentences, so that with 2 points credit for each perfectly completed sentence the maximum score possible would be 48 points. The median score and the range of the middle 50 per cent of the scores are shown in Table I for those pupils of the elementary grades who were tested with Scale A.

TABLE I

SCORES OF ELEMENTARY-GRADE PUPILS ON LANGUAGE SCALE A

	SCHOOL GRADE						
	II	III	IV	V	VI	VII	VIII
No. tested.....	1318	1437	1463	1507	1454	1456	1427
Median score....	4.59	8.99	14.33	18.39	21.92	25.27	28.06
25 percentile....	2.40	6.22	10.28	14.97	18.14	21.58	24.34
75 percentile....	6.57	13.04	18.60	22.02	25.36	29.08	32.42

In connection with Table I it is worth while to consider Table II, which shows the median scores of twelve-year-old boys according to the school grade in which they are found.

TABLE II

MEDIAN SCORES OF TWELVE-YEAR-OLD BOYS ON LANGUAGE SCALE A

	SCHOOL GRADE					
	III	IV	V	VI	VII	VIII
No. tested.....	22	62	155	269	217	76
Median score.....	10.5	12.9	16.3	21.6	24.7	29.8

[1] M. R. Trabue, "Some Results of a Graded Series of Completion Tests," *School and Society* (April 10, 1915), 537–40.

It would seem from Tables I and II that the ability measured by these completion-test sentences is related rather closely to the ability which teachers consider when promoting pupils to higher grades. Table III, showing the median scores of sixth-grade boys according to their

TABLE III

MEDIAN SCORES OF SIXTH-GRADE BOYS ON LANGUAGE SCALE A

	AGE						
	10	11	12	13	14	15	16
No. tested	70	201	243	164	74	30	7
Median score	23.4	22.6	21.9	21.1	18.9	17.6	13.3

ages, is interesting in this connection. This table furnishes evidence of a fact which needs to be emphasized. Teachers tend to retard the bright young chaps because they are "too young" and to promote the dull old fellows because they are "too old" for the grade. Possibly the most serious retardation problems in our American school systems arise from our lack of adequate provision for the exceptionally bright young children.

Scale A was given in a number of intermediate schools with interesting results. At Decatur, Illinois, four classes of Grade VIIA were tested. The median scores were as follows:

	CLASS			
	VIIA[1]	VIIA[2]	VIIA[3]	VIIA[4]
No. pupils	23	22	20	21
Median	28.3	26.9	25.5	23.7

After this result was noticed, I was interested to find that each pupil is classified, on entering VIIA, according to the judgment of previous teachers as to his general ability to do school work, those of greatest ability being put in VIIA[1], the next best group in VIIA[2], and so on.

In Grand Rapids, Michigan, those pupils in the eighth grade whose superior scholarship has been proved are allowed to take up the study of Latin. The median score of the 28 pupils in the Latin group was 34.0, with only one score as low as 27, while the median score of the 71 other

pupils in the same grade of that school was 29.8, with two scores of 17. Evidently the ability required to make high scores on Language Scale A is rather closely related to the quality for which teachers look when they attempt to select their brightest pupils for special work.

In view of the fact that ability to complete incomplete sentences is so obviously dependent upon ability to read and interpret printed words, it is not surprising to find that home training and nationality show an appreciable correlation with ability in these language scales. Three graduating classes in the elementary schools of Kansas City were measured on Language Scale A, with the following results:

	School		
	Hyde Park	Whittier	Hamilton
No. pupils	44	42	29
Median	33.4	31.3	27.3

The Hyde Park and Whittier schools are distinctly American, the first being in the best residence section of the city and the second being in a respectable middle-class district. The Hamilton School, however, is in a foreign district, one block from the Swope Settlement.

The writer found a similar situation in Bayonne, New Jersey. Three VIA classes were measured on Scale A, with the following results:

	School		
	Mann	Vroom	Lincoln
No. pupils	32	37	39
Median	23.6	20.4	19.2

The Mann School is largely American, the Vroom largely Jewish, and the Lincoln largely Slavonic in student population.

The completion test is not proposed as a substitute for the judgment of teachers in promoting pupils, but rather as an aid to it. Employing one of these scales will call attention to those children who have unusual ability to understand and interpret printed words and phrases. These unusual cases may then be investigated more carefully and such readjustments made as will allow these children to work under the most favorable conditions.

PART II

APPLICATION OF SCALES AND UNITS OF MEASUREMENT IN EDUCATIONAL SUPERVISION AND ADMINISTRATION

CHAPTER V

WORK OF THE DEPARTMENT OF EDUCATIONAL INVESTIGATION AND MEASUREMENT, BOSTON, MASSACHUSETTS

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The three phases of the work of the Department of Educational Investigation and Measurement, which will be described in order below, are: (A) measurement of educational results; (B) supervision of a revision of the elementary course of study; (C) the organization of a plan for the promotion of teachers on merit.

A. MEASUREMENT OF EDUCATIONAL RESULTS

I. *Arithmetic.*—The Courtis standard research tests in the four fundamentals were first given in Boston in October, 1912, by Mr. Courtis himself. Later they were given by others and have been continued to be given by this department. Their introduction into the Boston schools has been gradual, beginning with 21 districts in October, 1912, and covering the 70 elementary districts in May, 1915.

The tests have resulted as follows:

1. They have made possible the establishment of objective standards of achievement for Grades IV–VIII in addition, subtraction, multiplication, and division. These standards are based on the median score attained by large groups of pupils, and represent, therefore, the minimal achievement of at least 50 per cent of the children tested. These standards are shown in Table I.

2. These tests have shown the relative standing of each school, of each class, and of each pupil, in the 70 elementary school districts

tested, thereby providing the administrative officers with information as to the conditions which need improving.

3. They have revealed the ineffectiveness of the present general class drill in arithmetic on the four fundamentals, by showing that approximately one-third of the class gets more drill than it needs, another third makes fair progress, and the other third not only does not improve but, in many cases, actually loses in ability.

TABLE I

Grades	Time Allowed							
	Addition, 8 Minutes		Subtraction, 4 Minutes		Multiplication, 6 Minutes		Division, 8 Minutes	
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights
IV	8	6	8	6	6	4	4	2
V	9	7	9	7	7	5	6	4
VI	10	8	10	8	9	7	8	6
VII	11	9	11	9	10	8	10	8
VIII	12	11	12	11	11	10	12	11

4. They have demonstrated the need of drilling pupils in those four fundamentals in which they are deficient. To this end, a large number of the 70 elementary school districts have introduced several kinds of practice material in arithmetic, the relative merits of which are being studied by teachers and masters with a view to using that which proves most effective.

II. *Spelling.*—Proceeding from the fact that an eighth-grade pupil probably uses not more than twenty-five hundred words in his writing, whereas the spellers in common use contain from ten to fifteen thousand words, the department has worked as follows:

1. With the aid of many teachers minimal and supplementary lists of alleged difficult words have been prepared for each of the eight grades. These lists were placed in the hands of each teacher in the elementary schools, with the suggestion that the minimal list be emphasized in the spelling instruction (*School Document No. 8*, 1914).

2. The intention is by no means to limit the instruction to the words which are at present contained in the minimal list, but it is to make sure that the child learns to spell the words which he actually uses in his voluntary writing.

3. A test was given in May, 1915, to all grades above the second, for the purpose of determining the relative degree of difficulty of the words in the minimal lists.

4. As a result of that test each word is accompanied by a percentage, which indicates the number of pupils that spelled the word correctly. In this way each teacher is furnished with a list of alleged difficult words, together with information as to their relative degree of difficulty, thus making it possible for a teacher to place the emphasis in her instruction on the more difficult words (*School Document, No. 10*, 1915).

5. A further result of this test is to furnish each teacher with a standard by which she may judge whether her class is above or below the general standard for the city. If, for instance, a word is indicated as having been spelled correctly by 90 per cent of the children of the city, a teacher knows that if more than four out of the forty pupils in her class misspelled that word her class is below the standard ability of Boston children to spell that word.

6. A study has been made of the various lists of words that have recently been prepared as a result of scientific investigation, and the resulting list has been supplied to the teachers. It is the ultimate intention to make selections of words from this list to be added to the minimal lists until the minimal lists contain practically all of the words which are within the writing vocabularies of the normal pupils of each grade.

III. *English.*—Before the Department of Educational Investigation and Measurement was organized a Committee on Standards in English had been at work for some time and had set up some tentative requirements in English which the committee felt ought to be met by every pupil who graduates from the elementary schools. These requirements were approved by the Board of Superintendents and thus became authoritative standards. The requirements are as follows: Every graduate should be able:

1. To copy twelve lines of simple prose or poetry, and a bill of at least seven items. (Copying is not an end in itself, but a means to an end. The pupil should be made to see that accuracy in arithmetic, language, and other subjects may depend largely on accuracy in copying.)

2. To take down from dictation a passage of simple prose. (The purpose of dictation is to test language forms, punctuation, and spelling

already taught. It should never be used as a method of teaching. It should succeed and not precede a teaching lesson.)

3. To write from simple directions a friendly letter or an application for a position. (The letter is to be the pupil's own work, but he may be allowed to make corrections and to re-write. There should be no corrections by the teacher.)

4. To write within a half-hour a simple, original composition of not less than one page of letter paper, with every sentence grammatically complete. The pupil may make revisions, including interlinear corrections, but must not re-write.

In this composition the total number of serious errors in grammar, spelling, and punctuation should not exceed five—such errors, for example, as "I seen," "we was," "had wrote," "he try" for "he tried," "a women," the use of "they" for "there," "there" for "their," "to" for "too"; the misspelling of such common words as "Wednesday," "February," "eighth," "which," "stopped," "nineteen," "minute," "father," "mother," "English"; the omission of the period at the end of a sentence.

5. To recognize the parts of speech in their common uses; to explain the construction of words and phrases in a simple sentence containing not more than one phrase modifier in the subject and one phrase modifier in the predicate; to have a practical understanding of the uses to which the dependent clause of a complex sentence can be put—whether it be to serve as noun, adjective, or adverb; to know the principal parts of regular verbs and of the common irregular verbs, and their tense forms through the indicative mood.

6. To read at sight with readiness and good expression simple prose as difficult as *Little Men* or *Hans Brinker*.

7. To quote either orally or in writing fifty lines, not necessarily consecutive, of classic prose or poetry. (The pupil should look upon this not merely as something to be expected of him in the high school but also as a part of his equipment for life.)

8. To stand before the class and talk clearly on some subject of personal, school, or public interest.

The Committee on Standards in English is co-operating with the department in putting these requirements into effect. To this end, the department and the committee caused two tests to be given in

November, 1914, to 4,944 pupils in the first-year classes in the high schools. These tests were in accurate copying and in written memory work.

1. The test in accurate copying was to discover what degree of accuracy should be expected of pupils when they are asked to copy fifteen lines of prose in fifteen minutes.

2. The test in written memory work was to find out how well pupils remember the fifty lines of classic prose and poetry which the course of study requires that they shall have committed to memory before graduating from the elementary schools.

3. As a result of the test in accurate copying it has been found that boys will copy fifteen and one-half lines (4½ inches long) of prose in fifteen minutes, with 50 per cent of the pupils making less than five errors of any kind (spelling, capitalization, punctuation, words omitted, words added, wrong words used, misspelled words, undotted *i*'s and uncrossed *t*'s).

4. The same test shows that the girls will copy more than sixteen lines in fifteen minutes, and that 50 per cent of the girls will make less than three errors of any kind.

5. By giving a standard test under controlled conditions, it will be possible to give a similar test at some future date and determine whether or not improvement has been made.

IV. *Geography.*—In co-operation with the head of the Department of Geography in the normal school the department has given two tests to pupils in the eighth grade to determine:

1. How well pupils in the eighth grade remember the geography which they were taught in the earlier grades.

2. What ability pupils have to reason about geographical data.

3. Whether mere place-geography is being overemphasized in teaching.

V. *Penmanship.*—The quality of the handwriting of elementary-school graduates has been studied as follows:

1. Six-hundred specimen papers were selected from the 4,944 papers written in the test in accurate copying. The pupils were not aware that their handwriting was to be examined, hence they probably wrote in a natural, unrestrained manner.

2. These 600 specimen papers were rated according to the Ayres' Scale for Adult Handwriting, using only the specimens in the scale

under 90, 70, 50, and 30. Specimens poorer than the 30 specimen in the scale were rated 10.

3. The specimens were rated by a committee of six teachers who are superior teachers of handwriting. Each paper was rated by three persons.

4. The final rating of a paper was determined in the following manner: Where two or more persons agreed, that rating was given the specimen; where no two agreed, the middle rating was assigned.

5. A further study is being made of the merits and defects exhibited in these 600 specimens and a report will be printed and distributed among the teachers.

B. REVISION OF THE ELEMENTARY COURSE OF STUDY

In co-operation with two of the assistant superintendents the department is supervising the revision of the course of study in the elementary schools. In order to assist the teacher to economize her time and energy by the adoption of more definite purposes in teaching, these special features are being introduced into the course.

1. A concise, definite statement of the aims to be accomplished in the teaching of each subject in each grade.

2. A statement of the irreducible minimal essentials in each subject in each grade.

3. A definition of the objective standards of achievement in various subjects as far as they have been worked out.

This revision is being made with the co-operation of about 40 committees, including 359 different teachers, working on the following subjects: arithmetic, reading, stories and literature, spelling, grammar, composition, dictation, geography, and history.

This utilization of the knowledge, ability, and experience of the teachers will be followed by further professional educational advice from principals and superintendents. This method of course of study revision has the advantage of building up a practical course of study based on classroom experience, of securing the sympathetic understanding by the teacher of the course when it is adopted, and of affording helpful stimulus and proper encouragement to the teaching staff which must follow from such professional recognition.

C. ORGANIZATION OF A PLAN FOR PROMOTION OF TEACHERS ON MERIT

Inasmuch as the higher positions in the school service must be filled by the superintendent when vacancies occur, the department has proceeded on the assumption that any plan of promotion, honestly administered, is better than no plan at all. The need of a systematic plan is seen in the following phases of the conditions in the Boston school system.

1. The size of the public-school system, with its nearly two thousand elementary and over five hundred high-school teachers, makes it impossible for the superintendent to know the work of the teachers except indirectly.

2. The variety of ranks both in the elementary and in the high schools makes relatively a large number of promotions within the service.

3. The large number of candidates who hold certificates making them eligible for promotion makes necessary some further plan for determining their relative professional qualifications.

The scope and method of the work of the department to formulate a plan will be illustrated by the following brief statements:

1. Several conferences have been held with sub-masters and master's assistants, because they are among those most interested in a plan of promotion on merit. Among other things, it was agreed, subject to the necessary official approval, that (*a*) the sub-master in the school where the vacancy occurs should be given first consideration for appointment; (*b*) other qualifications being equal, that sub-master in the service longest as sub-master should be appointed first; (*c*) ratings of teaching ability and estimates of probable future success should be secured from (i) assistant superintendents, (ii) masters of schools, (iii) director of promotion and educational measurement.

2. At a conference with the Board of Superintendents a common basis for securing discriminating and comparable ratings was agreed on.

3. A comprehensive basis for judging merit has been prepared by the department after a study of the available plans of rating teachers in cities throughout the country (see forms 264, 265, 266, and 267).

4. From April, 1914, when the department began work, to June 1, 1915, the following higher positions have been filled in accordance with the proposed plan, in so far as it has been worked out at the present

time. All appointments to higher positions between these dates have been made according to the merit system.

In elementary schools:		
First assistant, grammar	Women	1
First assistant in charge	Women	7
Master's assistant	Women	5
Sub-master	Men	5
Master	Men	5
	Women	1
In high schools:		
Master, head of department	Men	1
Head master	Men	4

CHAPTER VI

THE APPLICATION OF STANDARD MEASUREMENTS TO SCHOOL ADMINISTRATION

D. C. BLISS
Superintendent of Schools, Montclair, New Jersey

A study of the educational literature of recent years reveals a steadily increasing interest in the possibility of the application of standard tests and measurements to the problems of school administration. Many prominent educators honestly question the value of such tests, because they feel that the most important elements in the mental and moral development of pupils are of an intangible character which can by no possibility be confined in terms of measurement. No one would dispute the fact that human life is a deeper and more complicated subject than can be probed by quantitative tests; nevertheless, when the more subtle components have been excluded, there remain some essential elements in education which are purely objective, and that these can be measured with reasonable exactness there is no reason to doubt. Because some things of supreme importance cannot be included in this category is no valid argument for rejecting the entire plan. We measure a man in terms of achievement; to apply to the schools the same test, the ability to produce results, is only logical and reasonable. The spiritual side of education is real and in all probability defies measurement, but a complete education includes elements other than the spiritual, and so far as they are present they can be measured. If they are so vague and indefinite as to escape measurement, their existence may well be doubted. The more clearly the objective results of education are understood, the greater the appreciation of the spiritual elements in the child's training. To reassure those who feel that any effort to arrive at a definite knowledge of educational values carries with it the danger of obtruding commercial methods into the region of things of the spirit, the well-proved truth may be reiterated here: the more clearly the objective results of education are understood the greater is the appreciation of the fact that unless all three natures, physical, mental, and spiritual, are being

definitely led toward their fulfilment, no system of child-training is even approaching the adequate performance of its function.

The mechanical application of standard tests with the resultant accumulation of medians, graphs, and charts is in itself a futile thing. Only as these tests are informed and controlled by a trained and sympathetic mind using the facts revealed as the basis of a constructive policy for future work do they find their justification. They show to a superintendent the extent to which his plans have been correctly interpreted and put into operation, and they furnish him with a sound basis for necessary changes, whether in the way of revision or of the introduction of new methods.

Because of the increasingly heavy demands upon the public schools, economy of time and of energy in every direction has become a necessity. Consider the relatively simple subject of penmanship. Once a pupil's handwriting was acceptable if the letters were well formed and the lines even, and the method of achieving this result was left largely to nature, or, when she had failed in the bestowal of the necessary gift, to the child's dogged patience in drawing over and over something resembling the copperplate sentence at the top of his writing-book. Now, writing has been differentiated from drawing, and every motion has been analyzed; unaccustomed muscles must be trained and co-ordination established; form must still be maintained, but the emphasis has been shifted to power; legibility must be accompanied by speed and a degree of freedom which makes it possible to continue the rapid, even movement for long stretches of time without fatigue. The problem before the school is how to meet these entirely reasonable demands without unduly prolonging the amount of time which may fairly be assigned to the subject. To this end the department of superintendence must know unmistakably every point of success or failure in the penmanship teaching and drill throughout the whole school system, that waste of time and effort may be eliminated. By what method shall the facts be ascertained most quickly and effectively?

Spelling is another comparatively simple subject, with a comparatively short time allotted to it in the school program. Questions like these face the teacher and the superintendent: Is the method in use producing accuracy? Is drill being wasted upon unusual words which will in all probability never find a permanent place in the child's vocabulary? Is drill on many words being carried beyond the point necessary

for fixing them in the memory? Has every child a limited working vocabulary which it is impossible for him to spell incorrectly?

Unsupported opinion can no longer be brought forward to decide, even in cumulative fashion, these and manifold other points which arise. What twenty eminent educators think as to the efficacy of a certain method gives way before the facts which careful investigation shows. Valid conclusions can be based only upon the results of accurate tests applied to large groups and continued for a sufficient length of time to eliminate possible error. If, as has already been said, such tests result only in the mere accumulation of educational statistics, they fail to justify the attendant expenditure of time and energy. They must surely function in an improvement in schoolroom practice or they are worse than useless. Unfortunately, it is precisely at this essential point that the vitality which should inform the laboriously acquired statistics is allowed to escape, leaving an inert mass of figures to show that someone has been busily and vaguely occupied about something. In education, as in every other department of life, the demand is not "Be busy about something," but "Be busy to some purpose."

So simple material as the relationship of "age and grade" should be carefully interpreted, and the inferences drawn from it should be a factor in shaping the school policies for the ensuing year. Percentage of promotion, "mortality" both in the grades and in the high school, the number of pupils accelerated or retarded, and other data of this character furnish evidence for a diagnosis of the health of the school body.

As a case in point may be cited the age-and-grade table of the Montclair, New Jersey, schools for September, 1912, which showed 23 per cent of retardation. Since this seemed too large for such a community, the superintendent and principals met for a discussion of plans looking toward the improvement of the situation. No radical steps were taken, but the schools were fully aroused to their responsibility for the excessive number of repeaters, with the result that the needs of individual children were given more careful consideration and a greater degree of flexibility was infused into school administration. In September of the following year figures were compiled on the same basis and the totals, which showed a decided improvement, formed the subject of another discussion. Four years of this policy have reduced the percentage of retardation almost 50 per cent.

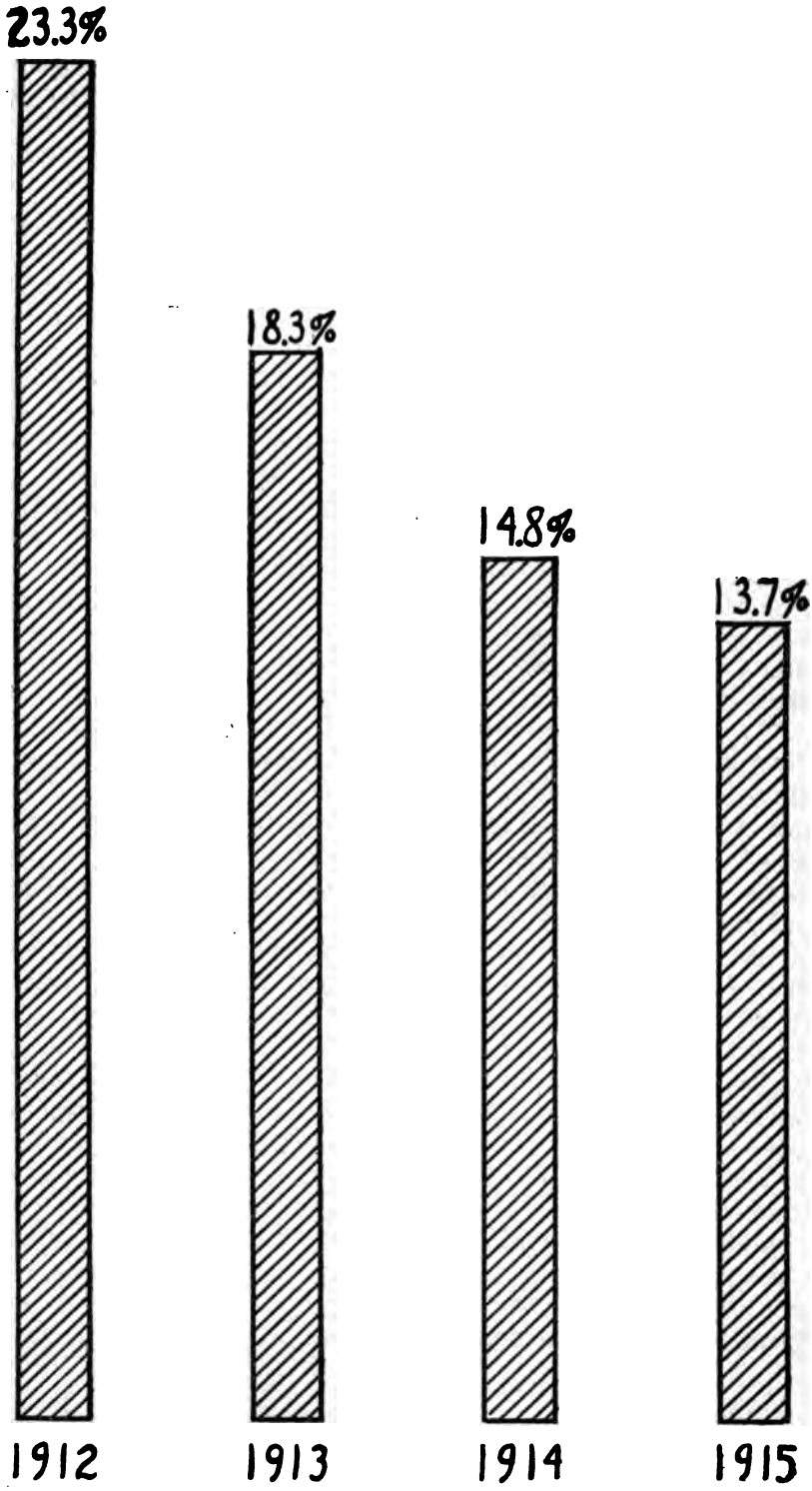

Chart I.—Percentage of retardation in Montclair schools in successive years, showing steady reduction.

The same general plan for determining values can be applied to such questions as the wisdom of the establishment of open-window classes, which, it may be said in passing, should be distinguished from the open-air classes—a wholly different problem. The argument in favor of open-window classes seems faultless. Fresh air is essential to health; it has proved effective as a healing agent in cases of tuberculosis. Anaemic children are benefited by open-air rooms. The inference is that healthy children will show a still greater improvement, owing to their better physical status. The theory seems flawless, but we need to assure ourselves that the facts accord with the theory, and the only way to determine this is to test it. One test is to weigh the children of the open-window class at certain intervals and then compare the change in weights with the change in weights of an equal number of children who are in a classroom of the usual type. The chances are that a superintendent who has before him such a record as is shown in Chart II will hesitate before extending the plan to his entire school system. Especially will this be true if other tests of a different character point to the same conclusion.

In dealing with subnormal pupils the opinion generally prevails that they should be given a form of education in which the manual arts predominate. It is also believed that defective children who seem to learn readily and are able to recite fluently are doing it in parrot-like fashion and that even this seeming facility will not long persist, that it is simply a case of learning something today and forgetting it tomorrow. Obviously, it is of great importance to the teacher to know whether this assumption is true of the individual pupils in her care, or whether she may stress the academic phase of her work with some hope of making an enduring impression. Only by testing the individual pupils is she able to determine the character of the training suited to each.

The possibilities of the standard scale for such children are shown by the records in penmanship and arithmetic of a subnormal class last year. A local scale, based upon that of Dr. Thorndike, was used to measure the quality of the handwriting of all members of the class, and this formal rating was made once in two months. The arithmetic scale consisted of ten problems in fundamental operations. A definite time-limit was fixed for the solution of these problems. No credit was given for incorrect results or omitted examples. The records made by a subnormal pupil in the two subjects appear in Charts III and IV.

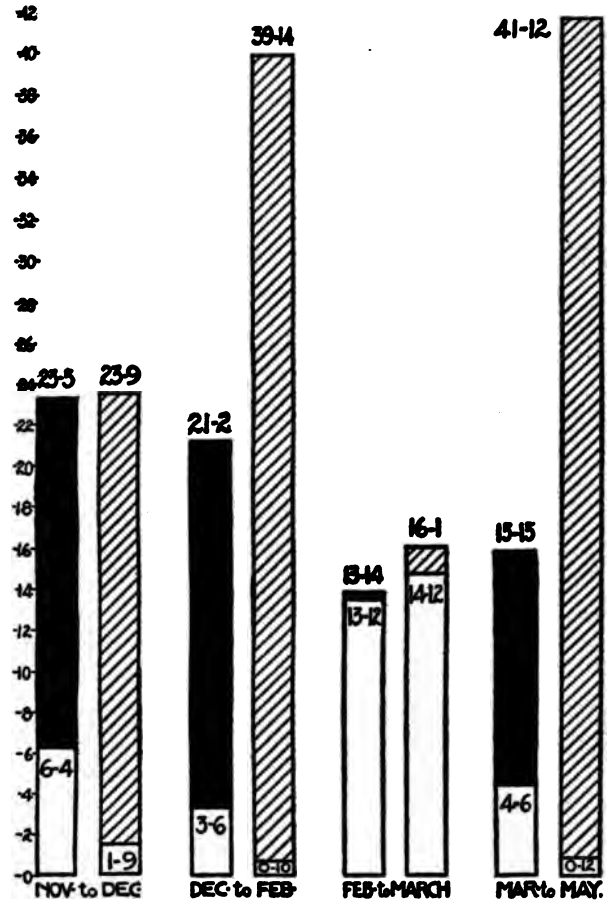

CHART II.—Gains and losses in weight of open-window class and of control class at Montclair, New Jersey. (The first column in each time group represents the open-window class, the second the control class. The entire height of the columns shows weight gain while the white portion records weight loss. Thus, from November to December the pupils of the open-window class gained 23 lbs. 5 oz. and lost 6 lbs. 4 oz., making a net gain of 17 lbs. 1 oz., which is shown by the blackening of the upper portion of the columns. During the same period the pupils of the control class gained 23 lbs. 9 oz., and lost 1 lb. 9 oz., leaving a net gain of 22 lbs. In every time group the control class showed a greater net gain than the open-window class.)

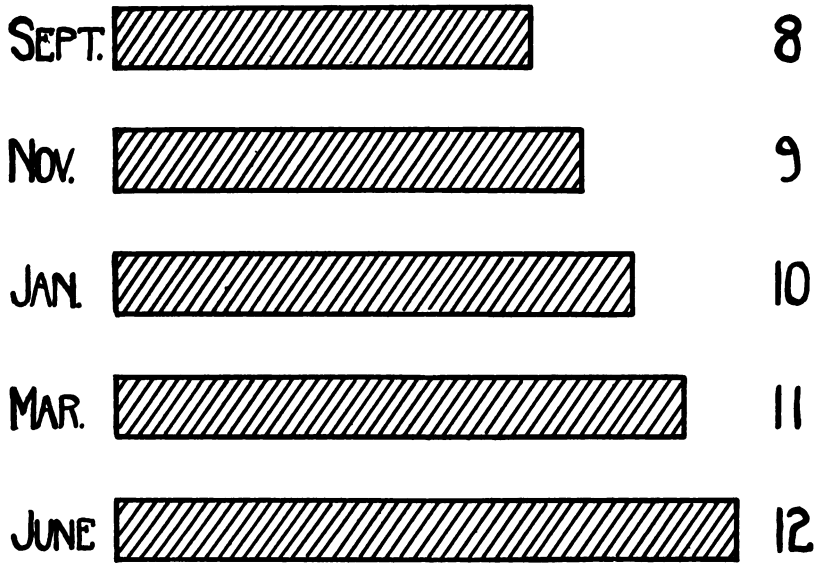

CHART III.—Performance in handwriting of a subnormal pupil. (The quality of the handwriting is indicated by the length of the hatched oblong and also by the digit at the right. The improvement is steady from September to June.)

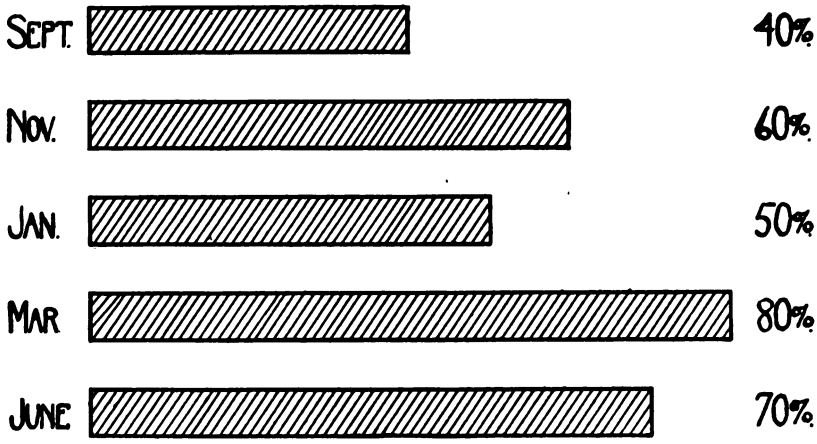

CHART IV.—Performance in arithmetic of a subnormal pupil. (The figure at the right shows the percentage of correct answers.)

In the purely mechanical process of writing there would seem to be no doubt that this pupil benefited directly from the teaching. In arithmetic the progress is not so evident.

The fact that the arithmetic test was confined to examples in fundamental operations of the same degree of difficulty made the tests practically uniform. It is very doubtful if a pupil whose record fluctuates to the extent indicated above receives any permanent value from such exercises. Similar charts made of every pupil in the class showed the same general tendency; improvement in penmanship was fairly constant, while in arithmetic frequent lapses appeared.

By the use of the standard scale the superintendent is enabled to check the results of any experiment in his schools and banish, from his own mind at least, any lingering doubts as to the wisdom or lack of wisdom of what he has undertaken. An experiment in one of the Montclair schools with a precocious class is a case in point. In September, 1912, in this school, a group of fourth-grade children of fairly uniform and

TABLE I

RECORD OF TESTS

	Fractions	English	Spelling	Writing	Fundamental Operations	Superintendent's Test Composition
Watchung VIIA....	83.6	81	98	11.6	78	42.2
Watchung VIIB....	86.9	80	98	11.2	80	45.4
Grove VIIA.....	77	71	97	11.4	69	45.4
Special group.....	87	83	97	11.1	83	45.8

superior ability was put in charge of a strong teacher who was instructed to allow the class to advance as rapidly as it desired. No pressure was ever brought to bear upon the pupils, but dawdling was discouraged. The class remained with the same teacher for two years and in this time did three years of work. Four months after the special group entered the seventh grade, careful tests were made to determine to what extent the experiment had been a success or failure. A comparison of the record of the special seventh-grade pupils with that of the entire seventh grade with which they had been merged and with two other seventh grades of a similar type showed a very gratifying situation. Tests in spelling, arithmetic, and English were given by the principal and a

standard test in composition by the superintendent, while the penmanship was rated by the writing supervisor. A conclusion based upon the results obtained from these three separate and independent sources can fairly be presumed to represent the facts (Table I).

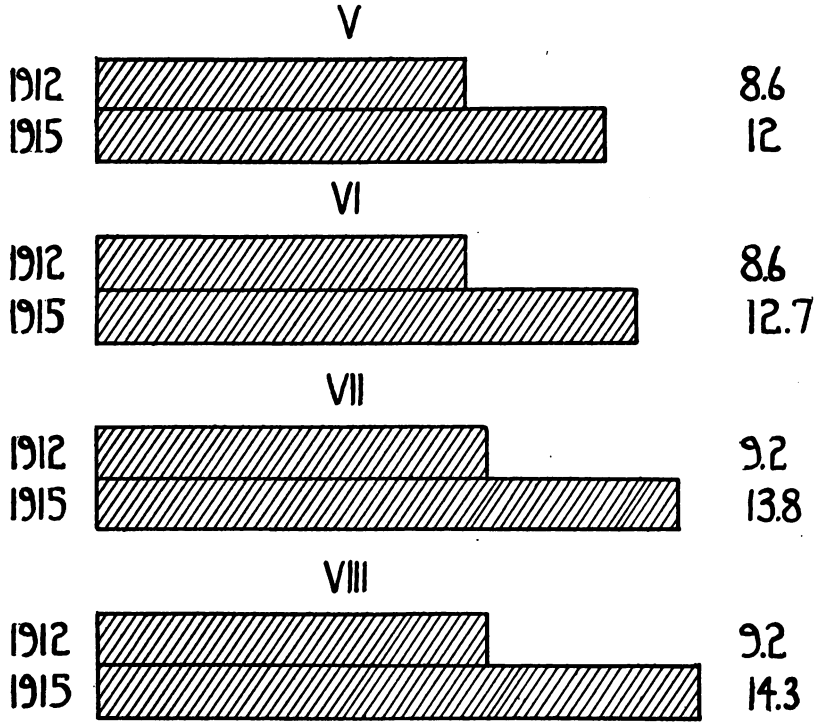

CHART V.—Improvement in penmanship in Grades V–VIII at Montclair, New Jersey, resulting from the use of a standard measuring scale. (The upper portion of each horizontal band represents the quality of the penmanship in the grade indicated in September, 1912. The lower portion shows the quality reached in June, 1915.)

It should be noted that the records in spelling, fundamental operations, complex fractions, and English show rank in percentage, while the penmanship rating and the superintendent's test are given in points and should be interpreted only as furnishing a basis for comparison.

That the children had not been advanced too rapidly is further indicated by the fact that all of them were regularly promoted at the

end of the year to the eighth grade, where they are now doing excellent work.

Standard tests are not only useful in bringing out the facts concerning pupils and classes, but are equally valuable in indicating general tendencies in the system as a whole. A recent school survey revealed the fact that in a certain system of schools the pupils in the fourth grade wrote practically as well as those in the fifth grade, while the hand writing of sixth-grade pupils was actually better than that of children in the seventh grade. Such a departure from a normal curve of advance may be justified by some unusual condition. However, the supervisory department should be fully aware of the facts if effective remedial measures are to be applied, and no amount of theorizing will furnish these facts. They can be obtained in only one way—by the application of one of the standard tests in penmanship. With the returns from such a test tabulated and charted, the situation in every grade is at least reasonably clear and a definite policy can then be formulated with some chance of reaching the root of the difficulty.

The effect of the use for three years of a standard penmanship scale upon the quality of the writing of public-school children is indicated in Chart V.

It is perhaps impossible to show by figures the total effect which tests of the type indicated here produce in the quality of the work of the schools. When purposeful effort is substituted for aimless drifting, there can be no permanent withholding of successful results. The only limits to investigation of this kind are those determined by the time which the supervisory department can afford to give to the work. It is based upon the fundamental idea of a continual local survey, made by those who know the actual school conditions, and who are seeking the facts as they exist, for the sole purpose of formulating constructive policies.

CHAPTER VII

A HALF-YEAR'S PROGRESS IN THE ACHIEVEMENT OF ONE SCHOOL SYSTEM

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SECTION A. THE PROGRESS AS MEASURED BY THE THORNDIKE VISUAL VOCABULARY TEST

The following report is based upon the responses of 754 pupils in the Bloomington, Indiana, schools to the Thorndike visual vocabulary test, which was given during the first week in February and again the first week in June, 1915. Only the papers of those pupils were considered who wrote both tests. The grades included are the IVB to the VIIIA inclusive.

The usual method of tabulating the results has not been followed, as the writer thinks that method not the best suited to show the actual achievement of any pupil; for example, the first two papers the writer took from a pile were each scored "line 7." In the first of these papers the pupil had made the correct response to every word in lines 4, 5, 6, and 7 and to one word of line 9. In the other paper correct responses had been made to every word in lines 4, 5, and 6, to four words of line 7, to two words each of lines 9 and 10½, to three words each of lines 8 and 10, and to one word of line 11. While both these papers were scored as of equal value, the writer is convinced that the ability of the second pupil should be rated as nearly double that of the first. By the method of scoring used in this report, the first pupil receives a mark of 119 and the second a mark of 214.3.

Assuming that the line values of the scale are correctly assigned (the Indiana results indicate that radical revision is needed), and that each word within any line is approximately of the same value as any other word of that line, why not assign a definite score for each word depending upon the line it is in? Such a marking scheme will give a pupil

credit for what he actually accomplishes in the test, and will have the added advantage of stating the pupil or class ability in one numerical result which can be treated statistically with greater ease than in the Thorndike scheme.

The papers in this report have been graded on this basis: every correct response in line 4, four points; line 5, five points; line 6, six points, etc.—line eleven, 18.3 points. The sum of all the word points represents the total value of the paper.

For comparative purposes the score of any paper or class median can be reduced to line and word values of the scale thus: line 4 has a range of value from 0 to 20; line 5, 21–45; line 6, 46–75; line 7, 76–110; line 8, 111–150; line 9, 151–195; line 10, 196–245; line 10½, 246–297.5; and line 11, 298–352.5.

By this scheme the ability of a pupil or of a class may be stated in fractional parts of a line or in terms of the first, second, etc., words within a given line; e.g., a pupil whose score is 126 has an ability equal to that represented by line 7 and 16 points additional, which is four-tenths of line 8, or two words of this line.

Table I shows the results of the February and June tests. The features to which attention is called are: (1) the score of each grade in the February test, (2) the gain from grade to grade in the February test, (3) the gain of each grade from February to June.

From this table the median gain from grade to grade by the February test is 18.8, or, stated in other terms, this gain is the equivalent of three words of line 6 or of two words of line 9. The greatest difference, 38.5, is between Grades VIB and VIA; and the least, 6.7, is between Grades VIIB and VIIA. The median gains within each of the grades between the February and June tests is 17.3; the highest, 37.5, is in Grade VIB and the lowest, 3.9, in Grade VIIIA.

It will be noted that the curves of Chart I show no marked plateaus and that the achievement in the VIB grade is double that in the IVB, while the VIIIA median is three times that of the IVB. This seems to indicate a steady and normal vocabulary development.

As comparable tests were not available, the same tests were given in June as in February. Whether the gain during the term is due to the natural growth in vocabulary on the part of the pupils or to their having remembered some of the words from the February test and looked

them up afterward as a matter of curiosity, I cannot say. I think the latter is true in only a very few cases.

TABLE I

THORNDIKE VISUAL VOCABULARY TEST (754 CASES)

Grade	No. of Pupils	Date	Score	P.E.	Line Value	February Difference between Grades	Gain during Term
IVB	91	Feb.	81.3	28.5	7.18	.....	
		June	92.5	28.5	7.5		11.2
IVA	85	Feb.	107.5	34.8	7.93	26.2	
		June	134.8	35.6	8.62		27.3
VB.....	65	Feb.	129.0	48.8	8.47	21.5	
		June	151.0	41.6	9.02		22.0
VA.....	102	Feb.	145.3	34.0	8.88	16.3	
		June	156.0	30.4	9.13		10.7
VIB	81	Feb.	164.1	43.0	9.31	18.8	
		June	201.6	43.5	10.12		37.5
VIA	83	Feb.	202.6	28.0	10.15	38.5	
		June	219.5	34.1	10.45		16.9
VIIB ...	62	Feb.	212.8	33.0	10.36	10.8	
		June	229.8	31.7	10.7		17.0
VIIA ...	69	Feb.	219.5	35.0	10.45	6.7	
		June	240.3	37.3	10.91		20.8
VIIIB ..	60	Feb.	238.6	35.0	10.87	19.1	
		June	256.1	32.9	10½.21		17.5
VIIIA ..	56	Feb.	254.1	36.7	10½.17	15.5	
		June	258.0	48.3	10½.24		3.9
Grade median		Feb.	183.3	34.9	9.73	18.8	
		June	210.6	34.8	10.28		17.3

To determine if any correlation existed between estimated teaching efficiency and class improvement in the vocabulary test, the writer secured the ratings of several competent judges on a considerable group of teachers in the grades from the IVB to VIIIA. In the IV and V grades where the work was non-departmental, the coefficient of correlation was negative; in the VI, VII and VIII grades where the teachers

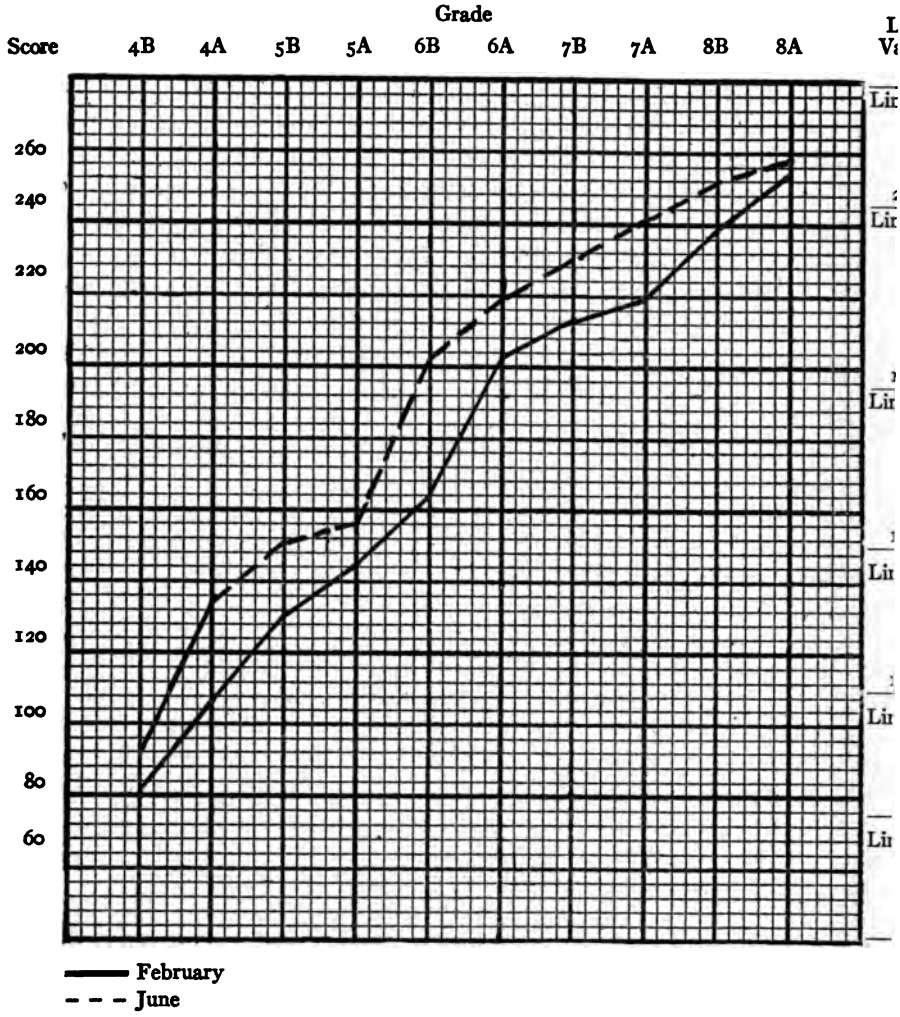

CHART I.—Graphic representation of the progress in visual vocabulary of 754 pupils at Bloomington, Indiana, based on Table I.

of reading and literature were employed for their ability in this line, the coefficient was between 0.6 and 0.7.

SECTION B. THE PROGRESS AS MEASURED BY THE COURTIS TESTS, SERIES B

During the second semester of the school year 1914–15, the writer, in conjunction with Mr. H. L. Smith, then superintendent of the Bloomington, Indiana, schools, gave the Courtis arithmetic tests in all grades of the elementary school from the IVB to the VIIIA, inclusive, for the purpose of measuring the growth in arithmetical achievement of pupils in this system. The tests were given during the first week in February and again the first week in June. The records of the 809 pupils who wrote both tests alone are included.

Table II indicates the number of pupils in each grade who wrote both tests and also the median number of attempts and rights, the percentage of accuracy, the percentage gain in rights, and the percentage gain in accuracy, for each of the four fundamental processes and for both the February and the June tests.

From this table the gain in achievement from grade to grade may be noted for the same date and for each of the processes; also the growth in achievement for each process between the February and June tests for each grade; and relative achievements in the different processes for the same grade and date may be compared.

In explanation of the results here set forth in comparison with those of other systems, it may be noted that formal work in arithmetic is begun in the Bloomington schools in the IIIB grade.

Table II and the accompanying charts show the following features worthy of note: (1) the slight gain from grade to grade in the February addition results for *rights;* (2) the marked gain in *rights* in addition of the June over the February results in Grades VI, VII, VIII; (3) a marked gain in *rights* in subtraction from grade to grade, but a decreasing ratio of gain between the February and June tests from Grade IVB to Grade VIIIA—there being an actual loss in achievement in rights in Grades VIIA, VIIIB, and VIIIA; (4) the slight progress in achievement in multiplication from grade to grade and the lack of improvement of the June over the February results except in Grade IV; (5) the marked gain in division from grade to grade in both tests but the lack of any marked improvement of the June over the February results in any grade —there being a moderate gain in Grades IV, V, and VIIIA; (6) that the actual achievements in attempts, rights, and accuracy in Grade IVB

TABLE II

ADDITION

Grade	No. of Pupils	Date	Attempts	Rights	Accuracy	Percent Gain in	
						Rights	Accuracy
IVB	95	Feb.	5.8	3.2	55.2		
		June	7.0	3.8	54.3	18.8	− 0.9
IVA	105	Feb.	6.7	3.5	52.2		
		June	7.9	4.4	55.7	25.9	3.5
VB	79	Feb.	8.1	4.5	55.5		
		June	8.3	4.6	55.4	2.2	− 0.1
VA	107	Feb.	8.4	5.3	63.1		
		June	8.4	4.9	58.3	− 7.5	− 4.8
VIB	83	Feb.	8.7	5.5	64		
		June	9.7	6.9	72	25.5	8.0
VIA	83	Feb.	9.0	5.3	59		
		June	10.5	7.5	71	41.5	12.0
VIIB	63	Feb.	9.7	5.6	60		
		June	10.8	8.1	75	44.6	15.0
VIIA	67	Feb.	9.8	6.0	62		
		June	11.8	8.4	71	40.0	9.0
VIIIB	65	Feb.	11.4	6.9	61		
		June	12.0	9.3	78	34.8	17.0
VIIIA	62	Feb.	11.5	6.3	55		
		June	13.7	10.4	76	65.1	21.0

SUBTRACTION

IVB	95	Feb.	5.2	2.6	50.0		
		June	6.7	4.7	70.1	80.0	20.1
IVA	105	Feb.	5.7	3.5	61.4		
		June	6.7	4.2	62.7	20.0	1.3
VB	79	Feb.	6.7	4.6	68.9		
		June	7.9	5.1	64.5	10.9	− 4.4
VA	107	Feb.	7.3	4.7	64.8		
		June	8.1	5.3	65.4	13.0	0.6
VIB	83	Feb.	8.0	5.5	69		
		June	8.1	6.0	74	9.1	5.0
VIA	83	Feb.	9.1	7.1	79		
		June	9.1	7.2	79	1.4	0.0
VIIB	63	Feb.	9.7	7.6	79		
		June	9.5	7.6	80	0.0	1.0
VIIA	67	Feb.	10.4	7.6	73		
		June	10.1	7.2	71	− 5.3	− 2.0
VIIIB	65	Feb.	11.0	8.8	80		
		June	10.8	8.3	77	− 5.7	− 3.0
VIIIA	62	Feb.	13.0	10.3	79		
		June	11.9	9.7	82	− 5.8	3.0

TABLE II—*Continued*

MULTIPLICATION

Grade	No. of Pupils	Date	Attempts	Rights	Accuracy	Percent Gain In	
						Rights	Accuracy
IVB	95	Feb.	4.2	1.9	45.2	68.4	9.0
		June	5.9	3.2	54.2		
IVA	105	Feb.	5.2	2.4	46.2	59.2	13.5
		June	6.2	3.7	59.7		
VB	79	Feb.	6.3	3.9	61.9	− 5.1	− 8.3
		June	6.9	3.7	53.6		
VA	107	Feb.	6.6	4.3	65.1	4.7	− 1.7
		June	7.1	4.5	63.4		
VIB	83	Feb.	6.7	4.3	64.2	2.3	2.5
		June	6.6	4.4	66.7		
VIA	83	Feb.	7.0	4.6	65.7	2.2	− 2.2
		June	7.4	4.7	63.5		
VIIB	63	Feb.	8.0	5.0	62.5	− 6.0	− 2.3
		June	7.8	4.7	60.2		
VIIA	67	Feb.	8.5	5.5	64.7	− 1.8	− 2.7
		June	8.7	5.4	62		
VIIIB	65	Feb.	9.0	6.0	66.7	3.3	− 0.2
		June	9.4	6.2	66.5		
VIIIA	62	Feb.	10.1	6.2	61.3	8.1	4.4
		June	10.2	6.7	65.7		

DIVISION

IVB	95	Feb.	1.3	0.5	38.4	260.0	2.5
		June	4.4	1.8	40.9		
IVA	105	Feb.	3.8	1.5	39.5	100.0	23.0
		June	4.8	3.0	62.5		
VB	79	Feb.	4.6	2.8	60.9	14.3	− 2.7
		June	5.5	3.2	58.2		
VA	107	Feb.	5.5	3.7	56.1	24.3	17.5
		June	6.3	4.6	73.5		
VIB	83	Feb.	6.0	4.6	76.7	− 6.5	−13.5
		June	6.8	4.3	63.2		
VIA	83	Feb.	6.5	5.3	81.5	1.9	− 0.9
		June	6.7	5.4	80.6		
VIIB	63	Feb.	7.4	6.0	81.0	6.7	6.7
		June	7.3	6.4	87.7		
VIIA	67	Feb.	8.8	7.1	80.7	5.6	4.5
		June	8.8	7.5	85.2		
VIIIB	65	Feb.	9.4	8.2	87.2	− 2.4	− 0.2
		June	9.2	8.0	87.0		
VIIIA	62	Feb.	10.4	8.9	85.6	10.1	2.7
		June	11.1	9.8	88.3		

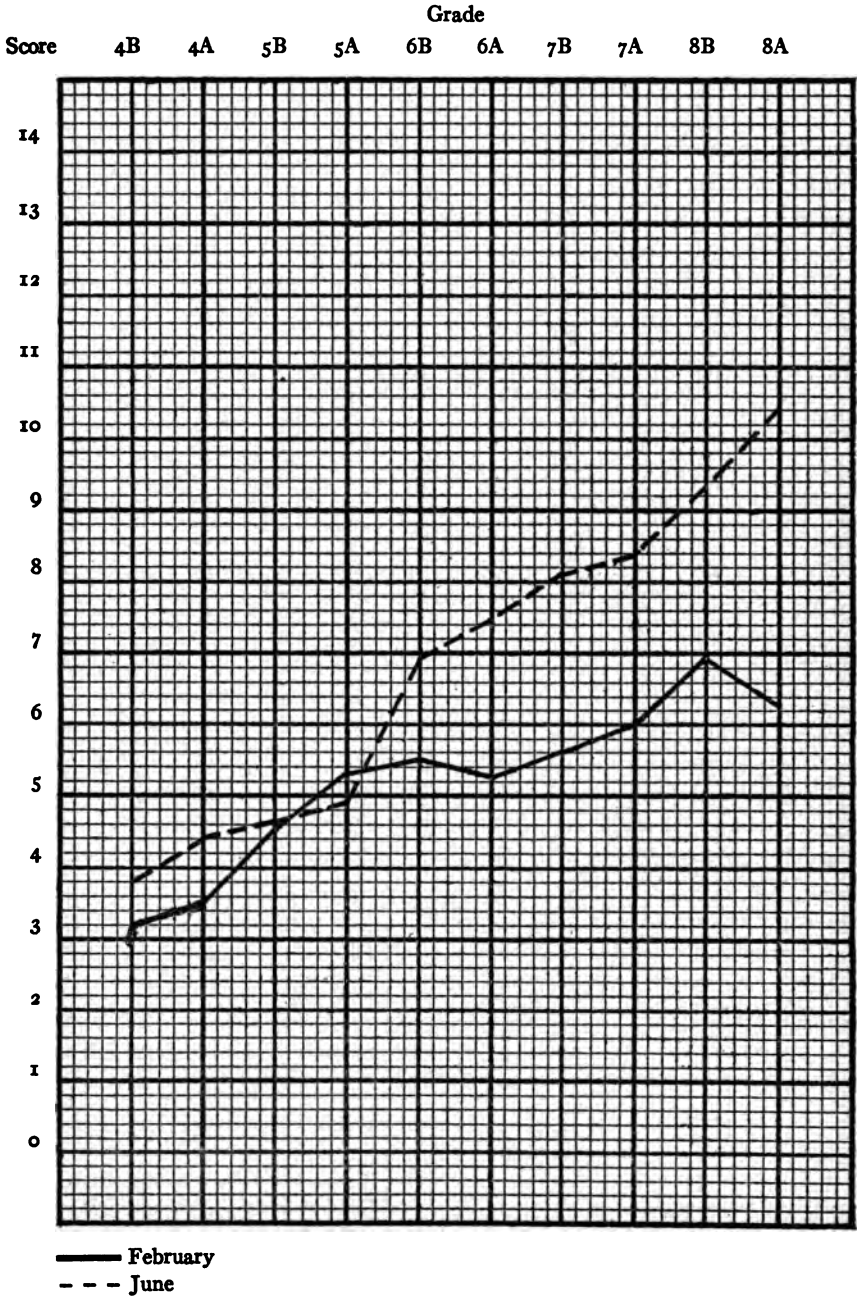

CHART II.—Progress in arithmetical achievement at Bloomington, Indiana. Addition, rights.

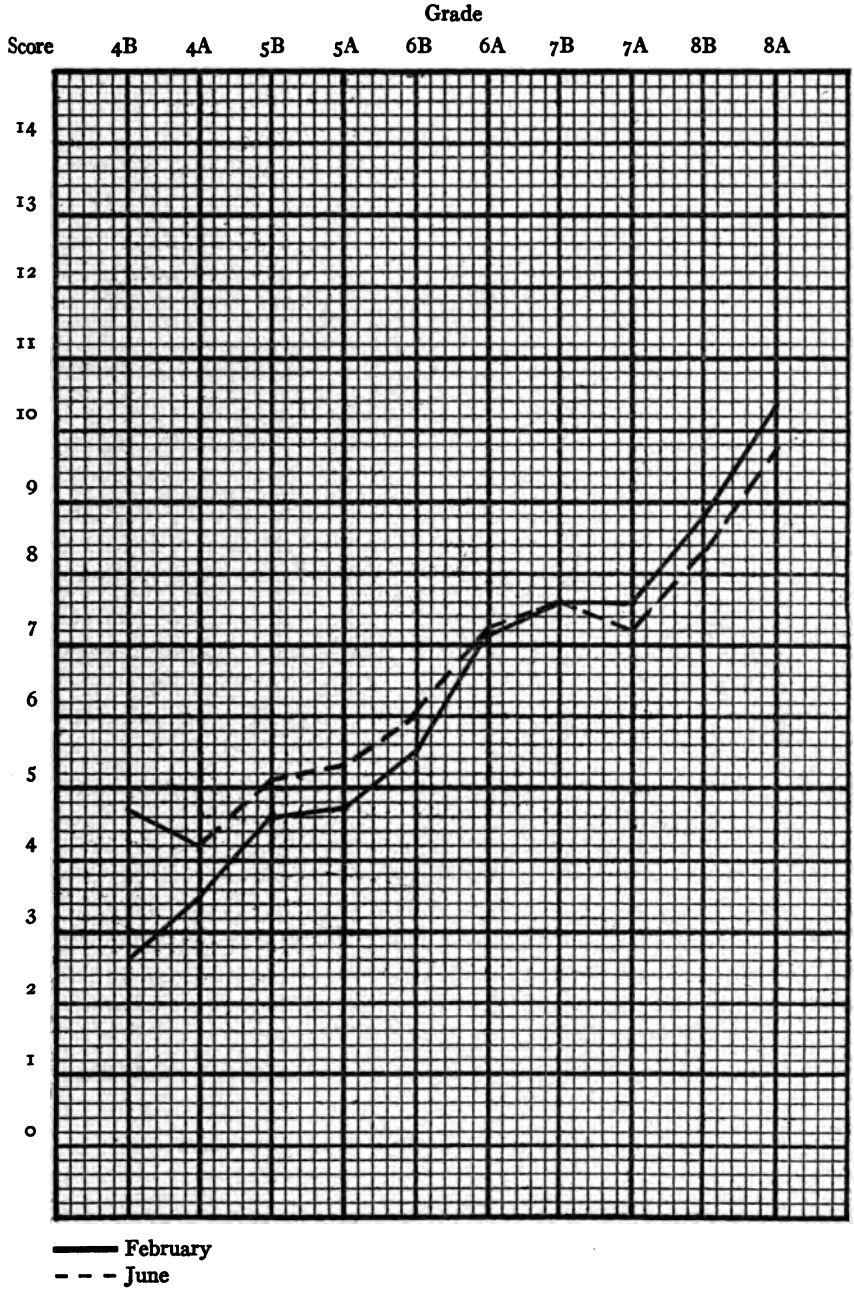

CHART III.—Progress in arithmetical achievement at Bloomington, Indiana. Subtraction, rights.

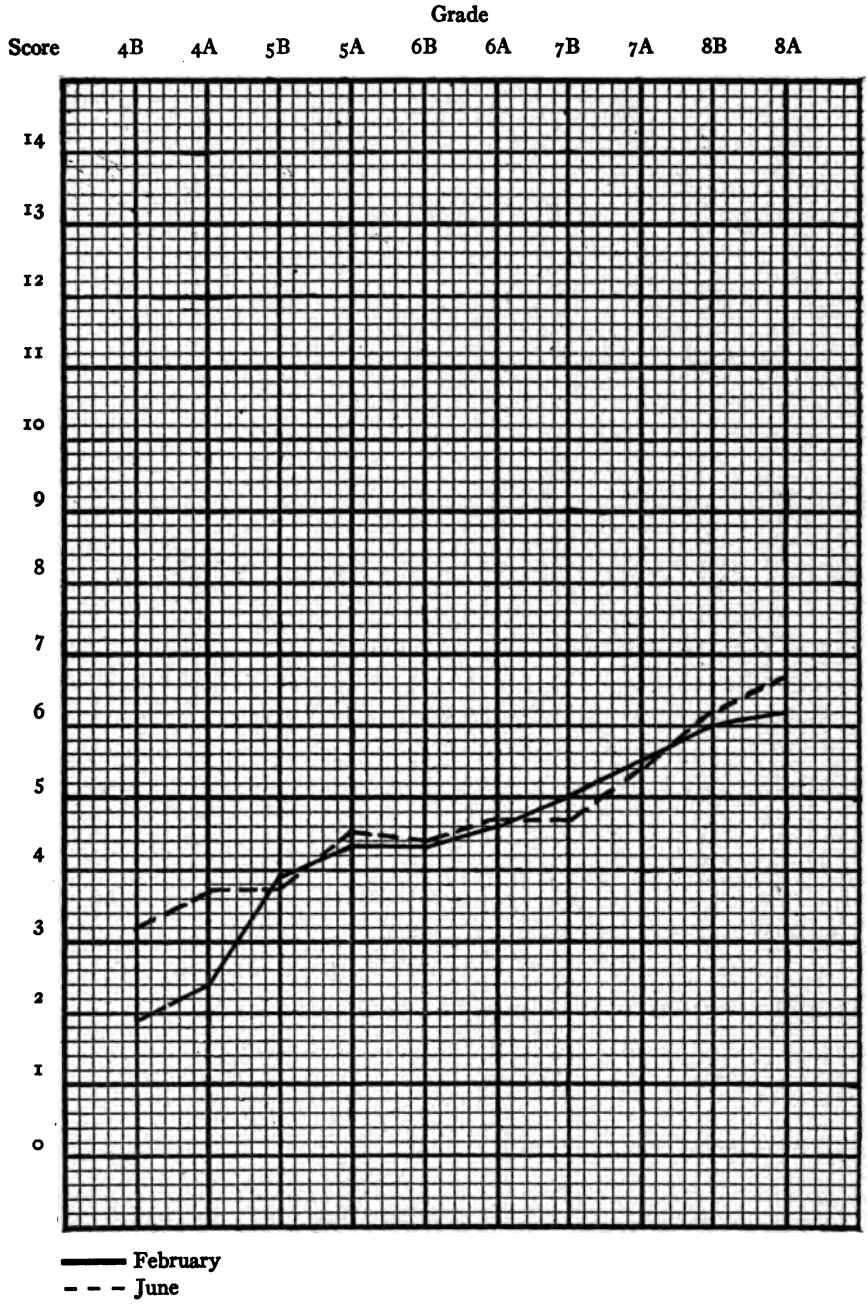

CHART IV.—Progress in arithmetical achievement at Bloomington, Indiana. *Multiplication, rights.*

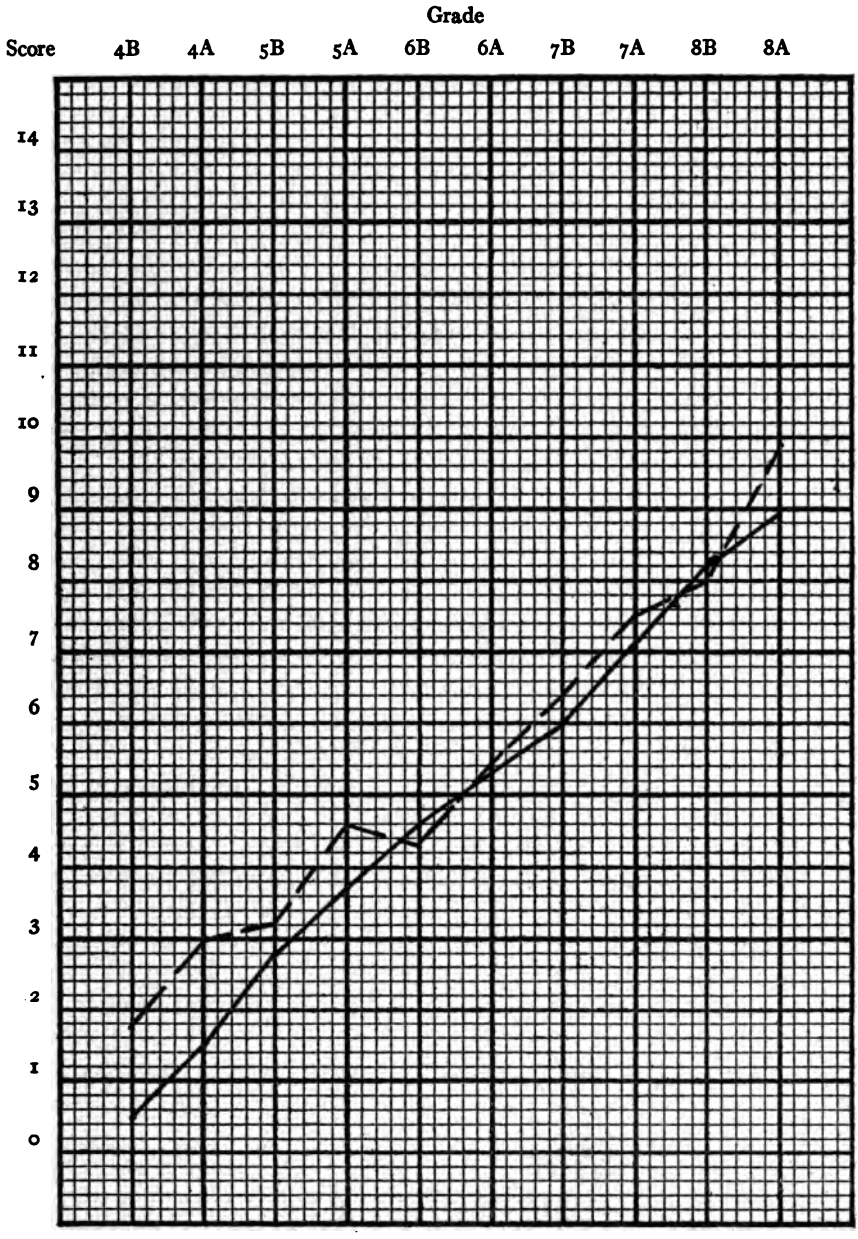

CHART V.—Progress in arithmetical achievement at Bloomington, Indiana. Division, rights.

are highest in the order of processes as follows: addition, subtraction, multiplication, and division. In Grade VIIIA (save for the drill influence in addition) the order is division, subtraction, addition, and multiplication—the latter two have about equal rank; (7) that the increase in accuracy from grade to grade is most pronounced in division, ranging from 38.4 in the IVB February test to 89 in the VIIIA June test; and is least pronounced in addition (save for the drill influence preceding the June test); the percentage of accuracy as indicated by the February test is 55 in both Grades IVB and VIIIA.

The marked gain in accuracy and in rights between the February and the June tests in addition in Grades VI, VII, and VIII, is accounted for by the fact that a five-minute daily drill in addition was given for a period of ten weeks in the interval between the two tests in these grades.[1]

An average gain in rights of 42 per cent and in accuracy of 14 per cent in addition, under drill conditions between the February and June tests, in Grades VI, VII, and VIII, indicates that present standards, under conditions of ordinary class work, are no indication of what these standards should be when experimentation has shown the way to a better procedure.

The marked gain in results in addition between the February and the June tests and the lack of gains in the other processes in Grades VI, VII, and VIII indicate that results may be expected at the point where pressure is exerted and that there is no appreciable transfer of training from one process to another.

In grades from IVB to VIIIA, the teachers were rated as to their general efficiency by four judges and the averages of these ratings were correlated with the amount each teacher's class gains in arithmetic were above or below the median class gain, as measured by the February and June tests. In Grades IV and V, where the teachers have charge of all subjects, the Pearson coefficient was about +0.30, but in the departmental grades, where teachers of arithmetic are employed because of their proficiency in teaching this subject, the coefficient of correlation was above +0.90.

These results are offered as data from one school system only and are not to be considered as determined general standards of achievement and growth in arithmetical abilities.

[1] Acknowledgments are due to Miss Mary Kerr, principal of the departmental school, who planned and carried out the drill work in addition and assisted in the tabulation of results.

CHAPTER VIII

COURTIS TESTS IN ARITHMETIC: VALUE TO SUPERINTENDENTS AND TEACHERS

S. A. COURTIS
Supervisor of Educational Research, Detroit, Michigan

From August 1, 1914, to August 1, 1915, between four and five hundred thousand tests (455,007) of the various Courtis standard research tests were sent from Detroit to school men in 42 different states. This material was mainly Series B Arithmetic Tests, and the growth from the use of the tests by a single school in 1909 may be taken as an index of the growth throughout the United States of the interest in the movement for measurement. It should be evident at once that if this great quantity of material is being used so as to result in benefit to the schools tested, then measurement must be already exerting throughout the country a very widespread influence on the teaching of arithmetic. On the other hand, this extensive use of testing material may represent merely natural curiosity and an experimental trial by wide-awake school men of a new and much-discussed type of examination.

Fortunately, measurement itself is not on trial. The movement for measurement is merely an application of scientific methods to the study of educational problems. Both as a general method for the discovery of natural law and as a method of proved worth in education, the method of science rests on so sure a foundation that for a school man to declare that in his hands measurement has been a failure is to confess his own lack of training or his own incompetency. As for the Courtis tests, they were designed by the writer for a specific purpose, viz., to measure the effects of his own teaching and of methods invented to improve its efficiency. This purpose has been successfully accomplished. For the writer's own purposes the tests yield results which are satisfactory and which have fully justified the time and effort given to the testing work. Further, the returns received from other schools to which the tests were sold on the co-operative basis have yielded information which has proved of the highest professional interest and value to

him. Moreover, the tests have given satisfactory service in the hands of so many professors and students of education that their value as tools for educational research is well established. But whether or not either the method or the tests are of value to superintendents and teachers generally is quite a different question.

Accordingly, at the request of the chairman of the Committee on Standards and Tests of Efficiency, an investigation of this question was undertaken. The following letter was sent to 200 superintendents in 30 states, all of whom had recently purchased copies of the Series B Arithmetic Tests:

DEAR SIR:

I am in receipt of a request from the Committee on Standards of the N.E.A. asking for the conclusions of superintendents as to whether or not the use of the Courtis Standard Tests in Arithmetic has been of any value to them or to their teachers from the standpoint of school administration or teaching. Any statement that you may be willing to send me will be forwarded to the committee.

Thanking you for such assistance as you may be willing to give, I am,

Yours very truly,

S. A. COURTIS

At this writing replies have been received from 87 superintendents in 30 states and they are still coming in. The states represented are Alabama, California, Colorado, Connecticut, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

The general tone of these letters is remarkable for its enthusiastic commendation of the value of measurement to superintendents, teachers, and pupils. Such expressions as "Delighted with results," "Should not like to do without them," "Do more than anything else we have ever tried," or their equivalents, occur in the majority of the letters. Seven of the eighty-seven stated that their results have not been tabulated because of lack of time. Only two express dissatisfaction. The following letter represents the extreme of unfavorable comment:

Replying to yours of the 29th ultimo, I regret to say that I have not discovered any material benefit from the Courtis tests as we applied them last year.

If one had a large amount of statistical assistance they might be worth while, but as a superintendent with a limited force I question their value.

Yours sincerely,

[The name is omitted for obvious reasons.]

On the other hand, many of the other letters show a careful study of the problem and a thorough analysis and formulation of the benefits. The following letter is an illustration:

BURLINGTON, IOWA, October 4, 1915

Mr. S. A. Courtis
82 Eliot Street
Detroit, Mich.

DEAR SIR: The Courtis Standard Tests in Arithmetic have been of great value to me in indicating:

I. The school or schools in which there is a regular increase in ability of the pupils in the fundamentals of arithmetic. Such knowledge has enabled me to suggest to the principals in those buildings where there is no such regular increase in ability of the pupils methods of bettering the product of their teaching.

II. The room or grade in which there has been no increase in ability during the semester. This indicates in some measure the work which the teacher is doing. It affords the superintendent an excellent basis for discussing in detail with the teacher the faults or good points in her work.

III. The school or grades in which there is a tendency to emphasize the work of the fundamentals beyond what is reasonable. Teachers like to do what they can do well. Their interest in those subjects which they like sometimes carries them too far.

From the statements made to me by teachers and principals I am confident that the tests have *not produced* as good results as they should, but this is not the fault of the tests. As the teachers come to understand the purpose of the tests, the value of this work becomes more and more apparent to all.

I do not think that we care to give up the tests under any circumstances.

Yours very truly,

W. L. HANSON, *Superintendent*

It is to be regretted that space prevents quotations from many others. Replies were tabulated, as follows:

Replies			
Total replies received	87	Tabulations not completed	7
Unfavorable	2	Favorable	78

Benefits Mentioned

General answers only	17	Reveal needs of individuals	23
Comparison with other cities	14	Stimulate teachers	23
Comparison from grade to grade	7	Stimulate pupils	17
Reveal weak points in school work	11	Furnish standards	24
Reveal weak teachers	13	Furnish incentive or motive	16

The results do not lend themselves to statistical tabulation, owing to the variation in the forms used in expressing the same ideas. Other important uses appearing in these letters are "Measurement of the efficiency of various methods," "Measurement of the progress of individual children," "Value in grading," "Awakening of spirit of investigation among teachers," "Satisfaction of parents."

The conclusions to be drawn from the foregoing data are that for the most part the superintendents who applied for standard tests are making legitimate use of them for purposes of supervision; that these men value the comparison from city to city—made possible by uniform tests and conditions—as a check upon the main character of the work done in their own systems; that the use of standard tests results in the setting up of objective standards which affect the work of teachers and pupils favorably, both by making clear the goal to be attained and by furnishing motives for individual effort; that the tests are of great value in the determination of the needs of individual children and in the adjustment of school work in arithmetic to such needs; that the tests have some value, the amount of which is yet to be determined, in the judging of the efficiency of teachers and in determining the grades of children; that few superintendents are making use of the tests in a scientific study of the comparative efficiency of different methods of teaching.

The rapid increase in the number of tests that have been used each year is, therefore, probably due more to the value of the results secured than to mere curiosity in a passing fad. The use of standard tests for purposes of supervisory control under such conditions is sure eventually to have profound influence upon the teaching of arithmetic.

The writer is glad to have this chance to express his appreciation of the co-operation of the many school workers who have made this extensive experimental use of the research material possible. The financial burden and office labor of carrying on, without profit, a co-operative

venture totaling some $5,000 or $6,000 a year has not been light; neither has the labor of tabulation of returns. It is therefore gratifying to find that this work has been of real value to many superintendents, and the result of the investigations made for the committee will be to stimulate further efforts to secure standards of teaching efficiency and to extend the range of the testing material.

VALIDITY OF STANDARD SCORES

The first tests in arithmetic were issued in 1911 and distributed widely in an attempt to secure standards for use in the writer's own classes. The first tabulation of the returns obtained was in June, 1911, and every year since that date additional tabulations have been made. Series B tests were issued at the beginning of the year 1913–14, and standards based upon the first tabulations were issued in February, 1914. At this time, however, both the tests and the method had reached a stage of development which made possible effective work, so that no change in standards has been necessary since that time, although tabulations of larger and larger numbers of scores have been repeatedly made. The standard scores set for Series B are as shown in Table I.

TABLE I

STANDARD (JUNE) SCORES. SERIES B TESTS

Grade	Test 1 Addition	Test 2 Subtraction	Test 3 Multiplication	Test 4 Division
III	3	4	3	2
IV	5	6	5	4
V	7	8	7	6
VI	9	10	9	8
VII	11	11	10	10
VIII	12	12	11	11

Standard accuracy = 100 per cent.

The scores given in Table I represent approximately the median speed of work for the different grades and are based upon returns that are nearly nation-wide in scope. The range of variation in schools in different cities and states is approximately four examples above and below the median; i.e., in some school systems the median eighth-grade scores will rise as high as 16 examples in addition and others go as low

as 8 examples. Not more than five eighth-grade classes per hundred will exceed these limits, except as very peculiar and special conditions prevail. On the other hand, the range of speed of work in individuals varies from a score of but two or three examples to scores of twenty-four examples, the limit of the test.

The conditions from city to city do not show greater variation in achievement than are to be found in any one city, such as Boston or Detroit, where there is a large number of classes of the same grade. If returns from small cities or country schools only were tabulated, the median scores for any given grade would probably tend to be somewhat lower. The large-city school apparently emphasizes the drill work. The problem of setting of an adequate standard is, therefore, a difficult one. Any standard adopted must take into consideration the effect of a number of different factors. All things considered, it has seemed best to take as a standard of speed the median speed derived from tabulations of all types of systems. There should certainly be no attempt to press training in addition, for instance, to very high levels of ability at the expense of more important work, and very few school men are willing to neglect in any way training in such fundamental abilities as the four operations. Median *speed*, determined from a wide range of conditions, probably represents the optimal speed at which children can work. A trial in the classroom of such speeds as standards has yielded satisfactory results.

The question of standards of *accuracy*, however, is a much more difficult one to settle, because less information is available and there is more room for a play of personal opinion. The writer has as yet reached no conclusion in the matter, but is endeavoring to determine the degree of accuracy which it is practical to attain under classroom conditions. For this purpose it is necessary to set before teachers as a goal to be reached the highest ideals possible—i.e., 100 per cent accuracy—then to determine in terms of the percentage of the class reaching this goal the degree of success which it is possible to attain. For instance, the average percentage of children of the eighth grade who show median speed with 100 per cent accuracy in first draft work is between 5 and 10 per cent. Experiment proves, however, that it is easily possible to raise the group showing perfect accuracy to 20 or 30 per cent of the class membership and markedly to increase the number of children working with accuracies of 90 and 80 per cent. There is even reason to

expect that with proper methods of training and by employing standards throughout the whole school system, and without change in the time given to arithmetic, it will be possible eventually to secure perfect accuracy in from 60 to 75 per cent of the children. For the classes under his immediate control the writer prefers to keep the standards of median speed and 100 per cent accuracy as the goals to be attained. He recognizes clearly, however, that at present this choice of standards must rest upon personal convictions only, and school men should feel free to change these standards to suit their own opinions.

There are, however, certain facts, other than the achievements of the pupils themselves, which ought to be considered in the determining of standards. One of these is the social value of the abilities developed by school work. The writer has attempted to answer this question by the measurement of as many adults as possible.

The first attempt along this line was made in connection with a survey of the New York schools for the Committee on School Inquiry. Through the kindness and co-operation of Mr. W. D. Ernest, chief of Cadet Staff and member of the John Wanamaker New York Commercial Institute, the consent of Mr. Lynn, general manager of the John Wanamaker department store, New York City, was secured to the testing of 50 employees of the company. This group was tested precisely as if it had been a class of children in school. It met in one of the company's schoolrooms and was tested by one of the force of trained examiners used in the New York survey. Exactly the same tests and time allowances were used as for the children and the same procedure in conducting the examination and in scoring and tabulating the papers was followed throughout. Forty-one complete records were obtained. The subjects represented six different types of positions in the store and in numbers were as follows:

Auditing department	5	Salesmen	7
Billing clerks	5	Typists	3
Cashiers	8		
Clerks	13	Total	41

Two of the clerks and six of the sales people were men. The average age of the group was approximately nineteen years, ranging from fifteen to thirty years. The average term of service for the company, except for the group from the auditing department, was a little more than two years, ranging from two months to five years. The girls from the auditing

department are the product of the store's own training and the term of service for them ranged from eight to fourteen years. The wage paid any member of the group is determined by position and term of service, not by position alone. The amount ranged from five to fifteen dollars per week. Of thirty-six who reported the last grade attended in public school, seven

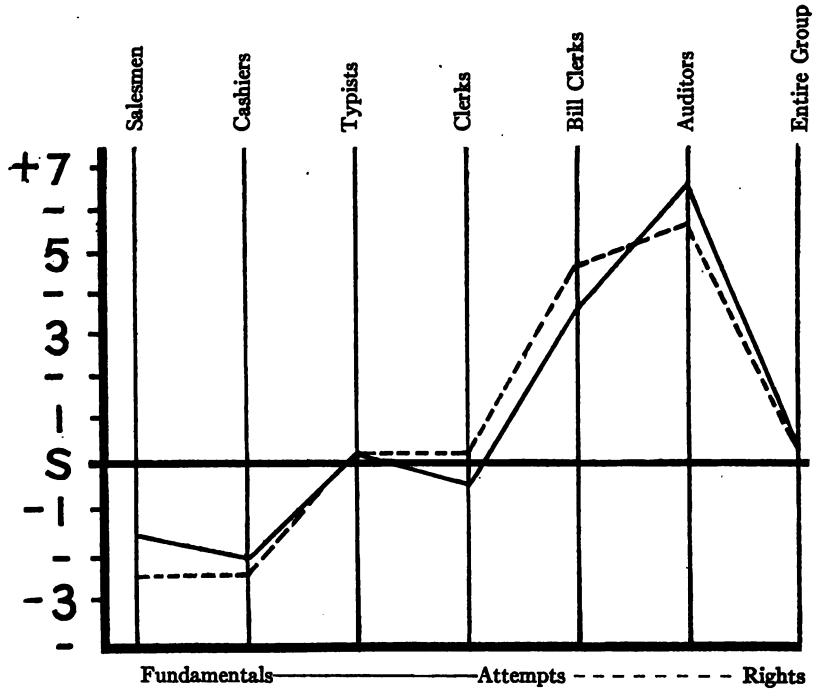

CHART I.—Line marked S indicates eighth-grade standard. Scale at left shows deviations above and below standard.

gave high school, thirteen had completed the elementary grades, and sixteen were in either the seventh or the eighth grade of the grammar school when they left.

It was not possible to attempt more than a general study of the work of the different groups. The cashiers do little more than make change; the clerks and salesmen have a little computation work in the handling of sales slips, store records, etc.; the members of the auditing department have a larger amount of abstract work and it is routine in

character. The auditing department and, to a lesser extent, the billing clerks are thus the only positions in which arithmetical ability would have more than a slight influence in determining the fitness of the applicant.

The tests used were Series A, and in Table II the results are given for Test 7 only, a test in the four operations with whole numbers. The scores given in this test do not differ markedly from those of Series B; the eighth-grade standard score is about 2½ examples higher. The results of the tests are given in Table II and shown in the graph (Chart I; see p. 98).

TABLE II

PART B. AVERAGE SCORES

Position	Attempts	Rights
Salesmen	12.9	7.7
Cashiers	12.4	7.7
Typists	14.7	9.7
Clerks	14.1	9.7
Bill clerks	17.8*	14.6*
Auditors	21.0*	15.4*
Entire group	14.4	10.4

* Computed scores. Entire tests finished in less than time allowed.

It will be noted that the scores of salesmen and cashiers fall below the eighth-grade standards (14.4 examples attempted, 10 examples right); those of the typists and clerks are almost exactly at standard; and those of the billing clerks and of the auditing department run considerably above standard. Two members from the auditing department had very high scores; the best one finished the test in so short a time that had enough material been furnished to keep her busy during the whole time allowed, her score would have been 38 attempted and 34 right.

Before commenting on these results, however, similar results from other sources will be presented. Through the co-operation of Miss Adelaide Baylor, clerk of the Board of Education for the state of Indiana, and the kindness of Mr. Jesse Moore, president of the Columbia School Supply Company, tests were given to a group of 66 factory laborers. These workmen were of three classes: a group of 20, mostly colored men, represented the cheapest labor employed in the factory, average

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wage 10 to 12 cents per hour; a second group of 26 men represented the median wage in the factory, average 17.6 cents an hour; a third type represented the best labor in the factory outside of the office, average wage 21 cents an hour. Tests were also given to a group of 13 saleswomen, ranging in age from nineteen to thirty-six. The average score made by these four groups of employees is shown in Table III.

Through the kindness of personal friends and the co-operation of Mr. Boyd Fisher, secretary of the Executive Club of the Detroit Board of Commerce, additional records have been secured from various types of adults. It is difficult, however, to obtain complete data in such cases, as information in regard to either age, salary, or occupation is likely to be missing. However, in Table III will be found the records of a group of low-wage girls ranging in age from eighteen to twenty-five, with average pay of $400 per year; 3 stenographers, age eighteen; 5 adult women, ranging in age from thirty-seven to forty-six, who give their occupation as housewife; a group of high-wage women ranging in age from twenty-one to forty and in salary from $700 to $1,200 per year; 14 boys and men representing machinists, steam-fitters, bookkeepers, railway foremen, railway clerks, trimmers, and salesmen, ranging in age from nineteen to forty-four and in salary from $350 to $900 a year; a group of 7 high-priced men of independent means, ranging from thirty-seven to fifty-nine years of age; a group of 44 Iowa superintendents, ranging in salary from $800 to $4,500, and a similar group of Michigan superintendents, all about thirty-five years of age, and ranging in salary from $600 to $3,600; a group of 17 office employees of an automobile company in Detroit, ranging in age from eighteen to thirty-two, and in salary from $700 to $1,500 per year; a group of 28 employees of the City Gas Company, ranging in salary from $300 to $5,000 per year; a group of approximately 80 teachers, mostly women, attending the summer school of the George Peabody College for Teachers, ranging in age from twenty to forty-five. In Table IV, the individual scores of one of the groups are given in full.

It is evident from these tables that there is an apparent correlation between the earning capacity of adults and their scores, but whether this is a causal relation or not is another question. The fact that a man attains a high position in society is more likely to be due to the superior quality of his general abilities than to his ability in arithmetic alone. An able individual will profit more by school training than one less gifted,

TABLE III

SCORES IN SERIES B TESTS MADE BY VARIOUS GROUPS OF ADULTS

OCCUPATION	NUMBER OF INDIVIDUALS	AGE	WAGES	ADDITION			SUBTRACTION			MULTIPLICATION			DIVISION		
				Attempts	Rights	Accuracy Per cent	Attempts	Rights	Accuracy Per cent	Attempts	Rights	Accuracy Per cent	Attempts	Rights	Accuracy Per cent
Columbia School Supply Co.:															
Laborers	20	.....	10–12 cents	2.9	.9	31	2.9	.9	31	1.7	.3	17	1.0	.4	40
Laborers	28	.....	12–37½ cents	6.6	4.0	61	5.0	2.6	52	4.8	2.0	42	2.7	1.1	41
Laborers	20	.....	21 cents	8.0	4.8	60	5.7	5.0	87	6.0	3.8	63	3.8	2.6	71
Low-wage girls	5	18–25	$ 400	11.4	8.9	78	14.4	12.6	87	10.0	6.8	68	10.2	8.8	86
Stenographers	3	18	.....	12.0	9.0	75	17.3	12.7	73	12.7	9.0	71	14.0	12.0	86
Housewives	5	37–46	.....	12.4	9.8	79	13.0	11.4	88	9.0	6.8	76	9.2	7.0	76
Teachers attending George Peabody School for Teachers (summer)	.....	20–45	.....	12.7	9.5	75	16.2	12.8	79	11.7	9.5	81	14.6	13.9	95
High-wage women	4	21–40	$700–$1,200	14.2	11.5	81	23.2	18.2	78	15.5	13.7	88	16.7	16.0	96
Saleswomen	12	19–36	.....	14.8	12.0	81	11.9	8.8	74	10.0	6.4	64	8.1	6.0	74
Office employees, Automobile Co.	17	18–32	$700–$1,500	18.7	15.2	81	19.2	16.6	86	16.0	12.9	81	16.4	15.5	95
Miscellaneous	14	19–44	$350–$ 900	16.2	13.3	83	15.4	14.1	91	12.0	9.3	77	9.8	8.6	88
Iowa superintendents	44	.....	$800–$4,500	16.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Michigan superintendents	35	.....	$600–$3,600	.....	.....	.....	.....	.....	.....	15.0	11.8	79	.....	.....	.....
High-wage men of independent means	7	.....	.....	19.1	17.0	89	18.6	15.6	84	12.3	10.7	87	10.3	9.7	94
City Gas Co	28	.....	$300–$5,000	21.0	18.0	86	18.0	15.5	86	16.5	13.0	79	16.0	13.2	82

as Thorndike has shown. Nevertheless, the fact remains that individuals who occupy positions of large earning capacity have greater ability in the four operations than those of less earning capacity.

TABLE IV

INDIVIDUAL SCORES: OFFICE FORCE—AUTOMOBILE COMPANY

MONTHLY SALARY	AGE	DEPARTMENT	TEST NO. 1		TEST NO. 2		TEST NO. 3		TEST NO. 4	
			Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights
$24.00	14	Office boy	.....	.....	.....	.....	13	6	11	8
60.00	18	Estimating	21	19	23	20	21	18	17	13
65.00	21	Drafting	10	2	9	9	11	7	5	3
65.00	22	Estimating	18	13	22	16	16	14	23	23
65.00	21	Engineering	16	14	18	17	16	13	17	17
65.00	21	Estimating	10	5	10	6	7	3	12	10
70.00	26	Order	16	14	14	13	14	10	12	12
70.00	24	Estimating	24	23	24	24	24	22	24	24
70.00	24	Estimating	18	11	17	14	12	10	16	16
75.00	24	Drafting	12	5	16	9	15	8	15	14
75.00	27	Timekeeper	24	22	24	19	19	17	12	11
75.00	25	Cost clerk	19	14	20	16	12	10	12	12
75.00	23	.....	15	12	22	20	14	12	19	19
80.00	23	Cost clerk	24	23	22	20	19	19	24	24
85.00	24	Timekeeper	24	21	23	21	20	17	24	23
90.00	27	Bookkeeper	24	24	20	19	14	10	12	11
125.00	32	Accountant	24	21	24	22	24	23	24	24
Total			299	243	308	265	271	219	279	264
Average			18.7	15.2	19.2	16.6	16.0	12.9	16.4	15.5

The figures in the tables give some indication of the levels of ability to which it is wise to develop such skills in children; for it must be remembered that one of the functions of the elementary school is to equip children with the essential tools for their life-work. The elementary school is not at all concerned with vocational training. If a boy wishes to become an accountant, the development of additional degrees of skill in the four operations must be the work of the vocational school; for the elementary school is concerned only with the development of skill necessary to meet the demands of an average life.

The figures in the tables show that the level of ability represented by scores of 17 examples[1] would be adequate for the general demands of a

[1] See Chart II.

successful life. Tabulations of the actual scores of eighth-grade children, as has been mentioned above, indicate a median speed of 12 examples. Considering the changes in speed of work which take place from the fourteenth to the twenty-fourth year, owing to maturity alone, it is possible to say that 12 examples represent an adequate speed for the eighth grade. The records of adults so far tabulated thus tend to confirm the standards previously adopted as being suitable goals for the elementary grades.

For those who accept the reasoning in the foregoing paragraphs an important decision will need to be made at once. At the present time 50 per cent of the children already equal or exceed the speed suggested as standard, 12 examples in addition. Also 50 per cent of the children fall below this speed. It is evident that many children in the grades now require additional training to develop adequate speed and it is equally true that a very large number of children have already greatly exceeded adult skill. For instance, in the report of the survey of the school system of Salt Lake City, Utah, in addition 4 per cent of the eighth-grade children equaled or exceeded 16 examples and 27 per cent exceeded 12 examples. If a speed of 12 examples is adequate for the demands of life, then it is a waste of time to give the children additional work tending to develop their skill beyond this point; yet where 75 per cent of the children need such drill to a greater or less degree it is evident that there must be a large element of waste in any form of class training in addition. The adoption of standards carries with it the idea of limitation of the direct training to the standard adopted. For those who adopt the limitation of training as an educational principle new class methods must be devised which permit of the elimination of individuals from the drill classes as soon as the standards have been reached and the setting of the child's time free for more profitable work.

In this connection it is interesting to note that skill in certain individuals may develop almost without limit under additional training. Certain adults have finished the Addition Test No. 1, Series B, in a time interval which represents scores of 60 to 70 examples with nearly perfect accuracy in the standard time limit. The scores of certain eighth-grade classes in schools which give an excessive amount of drill show correspondingly high results for children fourteen years of age. As the standard is raised above 12 examples, however, it requires an increasing effort to reach the higher levels. Moreover, a sorting on the basis of salary

of the various scores made by men tends to show that after a certain critical level is reached additional degrees of skill do not necessarily mean greater earning power. In the graph shown in Chart II, for instance, the two axes represent scores in addition (number of examples attempted, Test 1, Series B) and annual salary. The various cross-marks represent the scores and salaries of individual adults. The circles

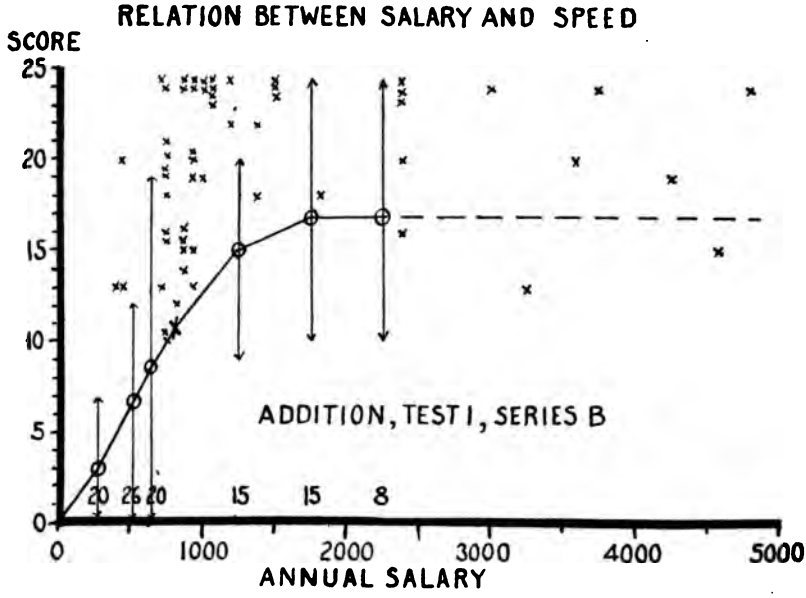

CHART II

on the curve represent the median scores of homogeneous groups of workers—first three, laborers; the last three, Iowa superintendents. The arrows show the range within the groups tabulated and the figures along the base of the graph represent the number of individuals in each group.

It will be seen from the graph that the curve tends to approach a maximum of 17 examples from a salary of $1,800 and up. It is to be noted, also, that even in the lower ranges of salary there are individuals of very high scores. The writer interprets the results shown to mean that in a general way earning capacity increases with ability to add, up to the critical value, and that beyond this limit additional skill has

relatively no effect upon earning capacity. Perhaps a better form of statement would be that the time soon arrives in a man's life when ability to add ceases to be a determining factor in his social efficiency. On the lower levels of general ability, ability to add may have more determining force than on the higher levels. All these considerations seem to point to limitation of training as a desirable procedure in the grades, and the general adoption of the scores recommended as standard with the consequent elimination from the drill classes of all individuals who reach this standard would undoubtedly improve the efficiency of teaching.

Standards of speed, however, are of little value in themselves, as the quality of work must also be considered. The results given in Table II throw some light upon a problem of accuracy also. There is apparent correlation between earning power and accuracy, and the levels of accuracy for the more capable groups range from 75 to 95 per cent, depending somewhat upon the operation. Children who attain fixed habits which enable them in straight-ahead work to maintain an accuracy of 85 per cent will probably be able to hold any position which is open to them. It is also probable that the final standard of accuracy adopted will be less than 100 per cent; but, as stated above, the writer is not yet willing to make a final statement in regard to such standards.

EFFICIENCY

With the adoption of definite standards for speed and accuracy efficiency may be defined in terms as rigid as those used in physical science. The efficiency of any test is the percentage of the total class membership which is able to work at standard speed with standard accuracy. Thus, if 12 examples in 8 minutes and 100 per cent accuracy be taken as standard scores, and if in a class of 40 there are 8 children able to equal or exceed these scores, the efficiency of the teaching would be represented by 8/40, or 20 per cent. The average efficiency of present-day teaching of addition ranges from 5 to 10 per cent if figured on this basis. If figured on the basis of a lower standard of accuracy (see standards adopted by Boston) the efficiency is, of course, largely increased. If standard tests are given at the beginning and the close of the year the efficiency of the teaching effort for the year would be represented by the difference between the initial and final efficiencies.

Such a definition of efficiency is, of course, open to the objection of unequal units, since to raise one child to standard scores may not be at

all equal to raising another child of very different initial abilities to the same scores. However, in any unselected class of 20 children the range of individual abilities will be so great that the objection of unequal units is of no practical significance. Further, it should be most carefully noted that efficiency, as here defined, is simply a measure of how completely the goals set as standards have been attained; it is not at all a measure of the movement within the class toward these goals. It is probable that a measure of this latter quantity is also needed. For the immediate problem for the future is the determination of standards of teaching efficiency in terms of objective scores for speed, accuracy, and amount of time given to the subject.

CHAPTER IX

USE OF STANDARD TESTS AT SALT LAKE CITY, UTAH

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In May, 1915, a survey of the public-school system of Salt Lake City, Utah, was conducted by a corps of five workers, of which I was director. One of the problems presented at Salt Lake City was that of estimating the efficiency of the instruction given. This was made especially important by reason of the fact that there had been much criticism in the city, on the part of the business men, of the instruction in the so-called fundamental subjects in the schools.

Accordingly, the survey force undertook to measure the instruction in writing, spelling, composition, arithmetic, and reading in the elementary schools of the city. For this purpose nineteen of the thirty schools were selected, with due care to touch every type of community from the standpoint of population, social and economic status, and general school conditions. The tests were used with the "B" or upper classes of each grade only. The tests used were those standard tests which have been employed in a number of other cities, and the methods used in giving and scoring the tests were as nearly as possible the same as in other cities, so as to get as nearly as possible comparable results.

1. *Spelling.*—The test in spelling was made by using the ten words selected by Dr. Leonard P. Ayres and used in the Springfield survey. The list of words was pronounced to the children by the regular classroom teachers in the presence of a member of the survey staff, and ordinary classroom procedure was followed with reference to such matters as writing, pronouncing words of more than one meaning, etc. The papers were then collected, immediately scored by the teacher, and turned over to the member of the survey staff who was present.

The results of the test showed that both by grades and for the city as a whole the spelling in Salt Lake City was particularly good. The average for the city as a whole was 86.0, as against an expectancy of 70.0. Individual schools averaged as high as 93.0, while the lowest

was 77.2. A more detailed examination of the results, however, showed large variations between rooms and among individuals within rooms. This is commented on at some length in the survey report. The general conclusions are that the test itself was entirely too easy, that for 40 per cent of the children it was no test at all, and that the city is obtaining a degree of efficiency in spelling beyond what might reasonably be expected of the schools. An examination of the time schedule also showed that the efficiency was obtained by an expenditure of time completely beyond what might reasonably be expected of a school system.

2. *Composition.*—For this test a brief composition was devised, similar to that which had been used at Butte and elsewhere, and the children were asked to express themselves on paper. The test was made in Grades IV–VIII inclusive. The scoring was done in terms of the Hillegas scale, not because this scale is itself a perfect one, but because it had been used in a number of other cities, and by using it comparable results from elsewhere could be set up beside the Salt Lake City results.

The general result of the test showed that the children were well qualified for language work, viewed as groups, but that individual children showed wide variations in their ability to use English. The variations were so wide that it was evident that the ordinary composition work could not be conducted in the schools without making it far too easy for some and far too difficult for others. The composition work did show some marked evidence of imagination and free expression, and the results, compared with those in other cities, showed that Salt Lake City stood well in the composition tests. It was clear from the results, however, that a better classification of the pupils within the grades would result in better composition work.

3. *Writing.*—Samples of the ordinary writing of the children in Grades III–VIII were taken, and these were scored by the Thorndike scale. The results of the test showed again that Salt Lake City ranks high compared with school systems where the test had been used, that the writing work was well up to the standard, and that the time involved was not unreasonably long. Median samples of the writing in each grade were reproduced in the report with the view to showing that the writing of the children in the schools did not offer the basis for the criticism of the school writing which the business men were wont to express.

4. *Reading.*—The new Courtis reading tests were used in testing the quality and quantity of the reading in a number of the schools, and these were supplemented by a number of personal judgments on the quality of the reading. While the reading test is recent and has not as yet been perfectly worked out, so that the members of the survey did not feel that the results were particularly valuable, yet the showing which the Salt Lake City schools made, indicated that the city ranked well in point of ability to read rapidly and remember what was read.

5. *Arithmetic.*—Two types of tests were made in arithmetic. For the first the Courtis standard tests in addition, subtraction, multiplication, and division were used, and the scoring was done in the manner provided for in the Courtis tests. The second test in arithmetic was one in reasoning, and for this the Stone reasoning tests were used. Compared with a number of other cities in which these same tests have been used, the schools of Salt Lake City stood high in the four fundamental operations. The city also stood well in the reasoning tests. Detailed tables and graphs were presented in the report to show the results by grades and by schools.

SUMMARY AND RECOMMENDATIONS

Sixty pages in the survey report are devoted to a detailed description of the tests made, and twenty-one tables and twelve drawings further illustrate the results. An attempt was made to draw from the results as shown certain conclusions and recommendations which would help the administrative authorities in the improvement of the schools. While one needs to read the entire chapter to get the full meaning of the conclusions and recommendations made, these may, nevertheless, be summarized as follows:

Conclusions.—1. Salt Lake City ranks high among cities of her class in each of the five studies in which tests were given.

2. In spelling, so large a percentage of children made a perfect score that full interpretation of the results is difficult. The city's average standing was 16 per cent above the standard.

3. In spelling, language, writing, and in the fundamentals of arithmetic, wide differences exist between the results shown for different schools.

4. The differences between grades are, with few exceptions, approximately what they should be.

5. The range of abilities in any given grade is entirely too great, as judged by all five of the tests.

6. Similarly, the range of abilities within a given class, again in all subjects tested, is far too great.

7. At least one-fourth more time is being given to spelling, and more than one-fourth more to arithmetic, than is justified in the light of the best knowledge on the subject.

Recommendations.—1. Spelling should not have more than 60 to 75 minutes per week, and arithmetic from 75 minutes in Grade II to 200 minutes in Grade VIII. A part of the surplus time from these two branches should be given to language work and part to other parts of the curriculum than the subjects dealt with here.

2. The only economical and pedagogical way of meeting the needs of the extremely dull and extremely bright pupils (perhaps from 4 to 10 per cent of each school class tested) is by a much larger use of ungraded rooms, to which the most skilful teachers should be assigned. It would be easy for all the larger schools of the city to find from 25 to 50 children who ought, for their own sakes and for the sakes of other children as well, to be placed in such rooms. This would provide an inestimable relief in all class work in the school. This is the most evident and the most important need which is brought to light by these tests.

3. The best and most constant supervision of this work is needed to secure the necessary readjustments. It should be added that, so long as the grade lines are stiffly maintained as the only basis for the classification of children, part of the value of expert supervision is nullified.

4. In addition to this, promotion by subjects ought to be a possibility more frequently made use of. When a fourth-grade child can read as well as a seventh-grade child he ought not to be kept in the fourth grade for reading just because he cannot leave his fourth-grade arithmetic.

5. Briefly, what the schools have achieved in general, they should now set themselves to achieve in particular.

CHAPTER X

READING

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Progress in the study of reading has been made since the report of this committee in 1915 chiefly through the opportunity supplied by the Cleveland survey to apply on a large scale the methods developed in previous studies. The Cleveland tests in reading fall into two fairly distinct groups. The first group was made with exercises selected from the readers commonly employed in the grades. In this group of tests the teachers of the whole city participated. The results show with clearness that teachers can conduct productive studies if a little supervision is provided, and that results secured by general studies of this type can be directly applied to ordinary school work. The second group of reading tests carried on in the Cleveland survey was made with standardized selections and demonstrates that a satisfactory degree of exactness can be attained even in so complex a subject as reading and that the methods of instruction in reading, especially in the upper grades, are in need of radical improvement.

The first tests in which all the teachers participated are described in the following directions sent to the teachers:

TESTS OF READING—CLEVELAND FOUNDATION SURVEY (May, 1915)

In order to make a study of reading, it is necessary to secure certain facts which are not ordinarily noted in everyday classroom work. Special methods will have to be adopted in order to secure these facts, but it is a fundamental mistake to think of these special recording methods as opposed in any way to the ordinary routine of classwork, or to think of them as replacing for either pupils or teacher the regular instruction. A recording device is good just in the degree in which it fits into the regular work and at the same time gives a series of accurate results on the particular point on which information is sought.

Rates of Reading.—All reading proceeds at some rate. Children in the same class differ in their rate of reading; children change in their rate of reading

as they go up through the school. It is desirable that we get some exact facts about these different rates, because rate is in itself important, because we find that rate and ability to understand are interdependent, and because rate is one of the symptoms by which we can readily measure the stage of development of the pupil.

Interpretation and reproduction.—Again, the power to reproduce is cultivated in all reading exercises. This power differs greatly in different children, and is affected by the kind of ideas presented in the reading matter. It is a more difficult problem to find out how much children understand and are able to reproduce than to determine the rate of reading, but we must carry our investigation far enough to determine, by studies of the power to reproduce, how far the teaching has been effective in cultivating the child's understanding.

Measurement as related to instruction.—Measurements of speed and power of interpretation will be worth collecting only when such measurements bring out the normal facts which are always present, but are for the most part unrecorded in reading exercises. Whenever asked to measure speed or power of interpretation, the teacher should be sure first of all that the process of measuring does not change the character of the exercise as a real class exercise. Have a normal lesson. Be sure in every case that the pupils get out of the exercise just as much instruction as though no recording of facts were going on, and follow the reading with the most productive instruction that can be given.

Learning to record facts.—The recording of facts presents certain difficulties. Usually a person who tries to record facts for the first time finds that he is distracted and inaccurate. The first principle which has to be laid down as applicable to all this work is therefore the following: Repeat each recording exercise several times until it becomes easy. Do not be discouraged if the record made the first time does not seem to go well. Furthermore, do not throw away the first record. It is worth keeping for purposes of comparison.

Uniform survey of reading.—This survey will aim to find out as much as possible about reading in the Cleveland schools. In order to make comparison easy the reading matter to be used for the final records of each type will be taken from the Jones Readers, which are in every school.

Teachers are urged to try the tests with other passages than these designated for use in all schools. The more frequently the test can be made with various kinds of material, the better prepared will the teachers be to make the final uniform test. Records should be kept of all tests made. The prescribed passages from the Jones Readers should be used on a given day in each building after sufficient preliminary practice to insure that the teachers know how to make the tests.

Throughout the preliminary practice and the final uniform test every reading exercise should be made a part of the regular instruction of the class.

Measuring the rate of oral reading.—The simplest measurement under the ordinary conditions of class work is probably a measurement of the rate of oral reading. This record can be made in any ordinary reading exercise. Do not let the children know that measuring is going on. Have them read as usual, but let the teacher have a watch and a pencil at hand. When a child begins to read, record his name and note the second at which he starts the paragraph. At the end of one minute put a mark in the book showing how much the child read. Let him read on without interruption to the end of the paragraph, as he would in any reading exercise. Make whatever comments or ask whatever questions would be asked in an ordinary reading lesson and then go on with a second child. After class count up the lines read by each member of the class in 60 seconds and tabulate the records. It will be found that there are certain differences in rate. Later we shall learn more about each child when we measure his rate of silent reading and when we measure his power of reproduction.

How the survey will use records.—By way of anticipation of the kind of use which will be made at the survey office of these results, it may be pointed out that a comparison will be made of different grades and of the records from various parts of the city. It should be stated explicitly that good reading cannot be judged by speed alone. A very rapid rate of reading in a second grade, for example, would show that the exercise is not a reading exercise at all, but a memory exercise. Too rapid reading in an upper grade would show lack of clear enunciation. No second grade and no eighth grade should stand out of its class, either above or below. It is possible, therefore, through a general comparative study to check up any single set of figures by the general results. If a single set of figures is to be useful, it should reflect the facts faithfully. Good records are faithful records, not exceptional records.

It may be appropriate to remark in this connection that these records are not to be used to the advantage or disadvantage of any individual. The value of the reading matter, the stage of development of the children, and many other general factors will be brought out by this broad survey. The method will also be useful in directing the efforts of individual teachers. The latter advantage is one which the survey ought to leave behind, but it does not fall within the scope of the survey to pass on individuals.

Measuring the rate of silent reading.—The second measurement is designed to bring out the facts regarding silent reading. All schools use silent reading in the requirement that pupils study geographies and histories, but too often

silent reading is lost sight of as a special problem for the reading-teacher. It may be difficult, because such work has not been emphasized, to have an exercise in silent reading which shall not impress the children as unusual. It is especially urged, therefore, that this part of the study be preceded and followed in every case by some real instruction and questioning. For example, when a passage has been read silently, as will be directed below, let the teacher immediately verify the reports made by various children by asking them about all parts of the passage, especially that which they report that they read last. Repeat the measurement and the questioning with both familiar and unfamiliar matter until the pupils come to realize what a silent-reading exercise really is. Furthermore, do not give any direction such as "repeat each word to yourself carefully," or otherwise try to influence the children to read silently by any fixed or prescribed method.

What is wanted is a clear record of how fast the child reads to himself in a normal way without skipping on the one hand, or without unduly careful looking at each individual word on the other.

It would be possible to take individual records of the rate of silent reading similar to those provided for in the section above on oral tests, but this is probably unnecessary, since the class as a whole can be measured without serious difficulties. Start the class off all together. In order to do this, let the teacher read aloud to the whole class in a normal way some part of the page immediately preceding that which is to be used for the test. When all come to the turning of the page, let the teacher stop reading and note the exact time. Let the children go on in accordance with a prearranged plan, each reading to himself, with the understanding that there are going to be questions asked about what he has read. At the end of a minute have each child close his book and report by reproducing on paper the last line which he read. He will not be able in most cases to report the line in exact form, but the teacher can judge by means of the written record how far the pupil has read. Now have some discussion of the passages so as to make sure that all read what they reported and that they read without skipping. After school, record the number of lines read by each. Try this several times.

A very good exercise for the pupils can be made of the requirement that they count the lines read, but their count should in each case be verified by the written record mentioned above.

Later tests.—Following these two kinds of tests will come others on the power of interpretation of the passages read. The detailed directions for these interpretation tests will be given out later.

Uniform test in oral reading.—After several preliminary tests of oral reading have been made by the methods described, and the results entered on the tabulating sheet, the uniform test should be given. In order that the pupils

of a given grade throughout the city may read the same material, the following selections have been chosen from the Jones Readers for this test:

Grade	Book	Selections	Pages
2A	II	Nathan and the Bear	94–100
		Ruff's First Adventure	118–123
3A	III	Peter Johnson's Boots	57– 60
		Rosamond and the Purple Jar	150–153
4A	IV	Prof. Frog's Lecture	116–126
		Queen Alice	129–136
5A	V	Golden Touch	29– 39
		Moses at the Fair	69– 71
6A	VI	A Gallop of Three	13– 17
		A Hunting of the Deer	47– 53
7A	VII	An Old-Fashioned Snow Storm	63– 66
		A Cellar in Siberia	77– 80
		Charley	20– 24
8A	VII	Surrender of Granada	161–167
		Destruction of Pompeii	176–182

At the conclusion of this test the results should be entered on a new tabulating sheet.

Uniform test in silent reading.—After several preliminary tests of silent reading have been made by the methods described and the results entered on the tabulating sheet, the uniform test should be given. The same tests will be given in each grade throughout the city. They will be taken from the Jones Readers, as follows:

Grade	Book	Preliminary Page	Test Pages
2A	II	101	102–103
3A	III	97	98– 99
4A	IV	61	62– 63
5A	V	47	48– 49
6A	VI	63	64– 66
7A	VII	73	64– 66
8A	VII	247	248–249

At the conclusion of this test the results should be entered on the tabulating sheet for the results of the uniform test in oral reading.

What the measurements show.—Teachers will note in their own results the following facts:

1. Children differ radically.

2. Passages differ in difficulty, but the various children in each class are likely to show fairly uniform relative standings whatever the character of the passages. Especially may it be noted that unfamiliar passages are sometimes easier than familiar passages.

3. The rates of silent and oral reading differ.

The directions as to procedure have been for the most part given in the foregoing discussion. The following details may be added:

In counting, be sure that a line which is shortened by a picture is counted as a part line.

At the end of a paragraph count all lines that are half-lines or more as though they were full lines. If such a line is less than a half-line, neglect it.

Be sure that you test in all cases for recognition of meaning, so that the pupils will not be tempted to skip or make extravagant reports.

Make all tests frequently enough so that you have confidence in your reports.

It is suggested that from the beginning each teacher try some written tests of the power to reproduce passages, so that when that kind of work begins for the survey there will be a clear notion of the precautions which are necessary.

Some of the typical results of these tests may be presented. First, the now well-known difference between the rate of silent reading and the rate of oral reading was brought to the attention of teachers by the results which they obtained. These results are reported in Table I.

TABLE I

NUMBER OF LINES READ ORALLY AND SILENTLY IN ONE MINUTE BY CHILDREN IN THE VARIOUS GRADES OF 43 CLEVELAND SCHOOLS

Grades	Lines Read Orally	Lines Read Silently
II	13	16
III	16	22
IV	14	21
V	15	20
VI	16	24
VII	16	21
VIII	16	21

No effort should be made to compare the results of successive grades with each other, because the length of the lines in different readers is different and the content of the passages is of varying difficulty. Even so, it is evident that children read more rapidly when they are free from the necessity of pronouncing words. The fact that there is not greater difference in the upper grades is undoubtedly due to the fact that school training emphasizes almost exclusively oral reading.

Fuller details of this contrast between oral and silent reading may be seen in Table II, which shows the results in full for the sixth grades of five schools.

Especially significant is the fact that the deviations from the medians are comparatively much smaller in oral reading than in silent reading. This means that children in a given grade are more alike in their abilities to read orally than in their abilities to read silently. This is explained by the fact that the limits of speed in oral reading are determined in part by the limits of the purely physiological process of articulation. All children in the sixth grade approach this physiological limit of speed in articulation. In silent reading, on the other hand, the widest differences are possible. That wide differences do appear is clearly shown by comparing the two columns in Table II marked "median deviation."

TABLE II

NUMBER OF LINES READ PER MINUTE IN THE SIXTH GRADES OF FIVE SCHOOLS

NAME OF SCHOOL	NO. OF PUPILS	LINES READ ORALLY				LINES READ SILENTLY			
		Lowest Pupil's Record	Highest Pupil's Record	Median Record	Median Deviation	Lowest Pupil's Record	Highest Pupil's Record	Median Record	Median Deviation
Addison.....	16	12	24	19	2.3	21	41	28	5.7
	16	11	23	14	3.2	15	32	21	4.2
Alabama.....	13	10	18	15	1.5	13	29	24	3.2
Bolton.....	35	9	20	16	2.0	8	44	15	9.5
	22	7	19	23	2.2	14	50	37	7.7
Boulevard.....	28	11	19	13	1.5	8	30	19	4.0
Brownell.....	32	6	24	14	3.0	15	55	22	6.0

The second set of tests—that is, the tests which employed, not the common passages from the readers in the hands of the pupils, but a series of selected and standardized passages—represents an advance in technique above the tests made by the whole system. The passages were standardized by Mr. William S. Gray. Without entering into the details of Mr. Gray's method, it may be stated in general terms that passages were selected by teachers and were then graded according to the results obtained after use with children of various school systems and various grades.

It is quite impossible to review in full the results obtained by the use of these standardized passages. Perhaps the most significant single result appeared in the fact that the more rapid the pupil's silent reading,

the higher his ability to reproduce what he has read. Some of the evidence establishing this conclusion is presented in Table III. Three passages were employed in this test, one by Grades II–IV, a second by Grades V and VI, the third by Grades VII and VIII. The table should be read as follows: In the second grade those pupils who read 100 words in from 102 to 98 seconds, inclusive, made an average quality grade of 17. Those who read 100 words in the shorter period from 92 to 88 seconds, inclusive, made an average quality record of 19. The table is based on data from 1,831 pupils in the Cleveland schools. The full significance

TABLE III

TABLE SHOWING RELATION OF SPEED AND QUALITY IN SILENT READING
(Based on data from 1,831 pupils in Cleveland, Ohio)

Grade	100 Words in 100 Seconds or 1 Word per Second	100 Words in 90 Seconds or 1.1 Words per Second	100 Words in 80 Seconds or 1.25 Words per Second	100 Words in 70 Seconds or 1.42 Words per Second	100 Words in 60 Seconds or 1.62 Words per Second	100 Words in 50 Seconds or 2 Words per Second	100 Words in 40 Seconds or 2.5 Words per Second	100 Words in 30 Seconds or 3.3 Words per Second	100 Words in 20 Seconds or 5 Words per Second	100 Words in 16 – Seconds or 6.5 + Words per Second
II.....	17	19	20	23	24	24	25	31	30	36
III.....	19	21	24	29	28	28	30	34	41	28
IV.....	.....	.....	.....	12	15	15	17	22	22	14
V.....	.....	.....	.....	13	20	20	22	26	24	33
VI.....	.....	.....	.....	19	27	28	22	28	30	23
VII.....	.....	.....	.....	.....	10	17	19	20	26	28
VIII.....	.....	.....	.....	.....	.....	19	21	25	29	18

of the table is brought out by reading horizontally along the line of each of the grades. Thus, for the second grade the score for quality improves steadily from 17 to 36 as the speed increases. For the third grade the score for quality improves steadily until the last stage, where there is an exceptional drop. It will be seen that in almost every case increase in speed is paralleled by improvement in quality.

The significance of this result for practical class work is at once apparent. Methods which will promote fluent, rapid reading will contribute in general to clear understanding and increase in power of interpretation.

The foregoing brief account of the results of the Cleveland survey will serve to show something of the character of the methods and outcome of the tests. More significant than any of the figures which can be

set down in tables, however, is the fact that these results can be used to improve the teaching of reading. This practical value of the tests can be made clear by referring to three distinct applications of the results in Cleveland which will be helpful.

First, the teachers are made aware by the tests which they themselves conducted of the importance of cultivating silent reading by methods different from those employed in oral reading exercises. Books on methods are full of advice on the teaching of oral reading, but they pass silent reading with a casual mention. Yet silent reading is the only form of reading commonly employed in later life. Silent reading is necessary for the pupil who studies geography or history or any other subject out of a textbook. It is accordingly important that the distinction be impressed on teachers.

Secondly, the methods of teaching generally employed in the schools tend to make pupils slow in their reading. It is very important that teachers learn from a comparison of their own pupils that those children who learn to be fluent by personal efforts are also the pupils who can reproduce most efficiently what they have read. This fact will serve to check all of the criticism which is sometimes heard against schools which aim to cultivate rapid methods of mental work. Speed is, within reasonable limits, a desirable quality. Speed in silent reading is distinctly a virtue.

Thirdly, there is the broad, general teaching of these tests. They show that exact, quantitative studies are highly useful in directing all kinds of school work. The arithmetic tests which have been so productively worked out by Courtis are accepted by teachers as naturally permitting a high degree of quantitative accuracy. Writing and spelling are thought of as readily reducible to quantitative grades because of their relative simplicity. When, however, exact statements can be made regarding reading, the central subject of the elementary course has been reached, and the value of exact investigations can be demonstrated more fully than in any other subject.

This final outcome is of such importance to schools in general that a chapter of this report has properly been devoted to a paper by a practical superintendent, Mr. Oberholtzer, setting forth his experience in conducting a quantitative study of reading.

CHAPTER XI

STUDIES BY THE BUREAU OF RESEARCH AND EFFICIENCY OF KANSAS CITY, MISSOURI

GEORGE MELCHER
Director of the Bureau of Research and Efficiency, Kansas City, Missouri

While bureaus of educational standards and measurements (research and efficiency) are engaged for the most part in applying to school work the objective measures that have been established, yet these bureaus are not standardized and no two of them are proceeding in the same way. However, many problems are common to all of them. Most of them co-operate with the superintendents of their school systems in the analysis of school statistics (some handling all the school statistics); they direct various forms of educational measurements, tabulate the results, and furnish the summaries and conclusions reached to superintendents, supervisors, or principals, to be used in improving educational practice. They also study the cost of various items of school expenditure and establish standards in school costs; they conduct various forms of school inquiries; they make careful scientific studies of any problem of school supervision or school administration. These bureaus are attacking the herculean task of substituting fact for opinion in school practice. For generations our schools have been conducted along the lines laid down by opinion and precedent. All other forms of business of great magnitude that spend vast sums of money, and affect the welfare of thousands of people, are being organized more and more in accordance with well-established principles, based on fact. Education is the greatest business in which the people are engaged, and this business affects more vitally than any other business the life of every person. It is right, then, that the people should demand of this enormous business enterprise accounts, both educational and financial, as complete, systematic, and accurate as any other business furnishes. The people should know what results they are getting for the vast outlay of money they are making.

During the past year the Bureau of Research and Efficiency of Kansas City has studied the following problems: (1) overageness and

its causes; (2) non-promotion and withdrawals and their causes; (3) opportunity for individual progress in schools; (4) comparative study of school elimination and school persistence for the past twenty-five years; (5) length of time required to complete the elementary-school course; (6) the efficiency of school work in (*a*) spelling, (*b*) handwriting, (*c*) fundamental operations in arithmetic, (*d*) accurate copying; (7) the cost of heating, lighting, water, janitor service, etc.; (8) grading and distribution of grades in the high schools; (9) revision of the reports and records of the school system so as to make them of greater educational significance; (10) exceptional children and their needs; also (11) several minor problems.

The work of the Bureau can best be illustrated by extracts from a few of the studies made. The following is part of a study showing method of attack on cost of heating.

A. COST OF FUEL PER PUPIL IN DAILY ATTENDANCE

The following table gives the 50 largest cities in the United States, arranged in the order of the cost of fuel per pupil in daily attendance during the school year 1912–13:

1. New Orleans	$0.37	26. Scranton	1.34
2. Richmond	0.37	27. Pittsburgh	1.35
3. San Francisco	0.40	28. Fall River	1.40
4. Nashville	0.46	29. Boston	1.41
5. Los Angeles	0.46	30. St. Paul	1.43
6. Birmingham	0.48	31. Providence	1.45
7. Atlanta	0.58	32. Minneapolis	1.49
8. Oakland	0.62	33. Toledo	1.52
9. Memphis	0.66	34. Philadelphia	1.52
10. Louisville	0.69	35. Buffalo	1.54
11. Paterson	0.71	36. Spokane	1.58
12. St. Louis	0.80	37. Jersey City	1.60
13. Newark	0.83	38. Columbus	1.61
14. Baltimore	0.92	39. Denver	1.67
15. New York City	0.96	40. Portland	1.68
16. Dayton	1.00	41. Washington	1.70
17. Bridgeport	1.03	42. Chicago	1.71
18. Detroit	1.09	43. Worcester	1.83
19. Cleveland	1.12	44. New Haven	1.84
20. Seattle	1.21	*45. Kansas City, Mo.*	*1.96*
21. Cincinnati	1.22	46. Omaha	2.10
22. Milwaukee	1.24	47. Syracuse	2.11
23. Cambridge	1.27	48. Rochester	2.27
24. Grand Rapids	1.30	49. Albany	2.37
25. Indianapolis	1.31	50. Lowell	2.70

From the foregoing tabulation it is seen that in 1912–13 only five cities in the United States paid more per pupil for fuel than did Kansas City, Missouri, and that only one of these cities was in the Central West. Investigation of coal prices indicates that the prices of coal in Kansas City, Missouri, are relatively high. However, after allowance is made for the higher price of coal, it seems probable that the cost per pupil for fuel in Kansas City, Missouri, is 10–20 per cent higher than in cities that are able to secure coal at about the same prices as are paid in Kansas City. In compiling the foregoing figures, the fuel used in the library building and library branches was deducted before making the averages. No deduction, however, has been made for coal used by janitors. In most cities coal is not furnished the janitors by the school district. The coal used by the janitors should not amount to more than 5 per cent of the bill. Thus it is seen that when allowance is made for the janitors' coal the cost of fuel is still relatively high.

It is fair to Kansas City to note that in recent years this school district has erected a large number of new school buildings, containing large schoolrooms, spacious hallways, gymnasiums, etc. Such buildings equipped with modern ventilating systems and other modern conveniences are necessarily expensive to heat.

COST OF COAL PER PUPIL IN DAILY ATTENDANCE

(Cities in Missouri, Kansas, Nebraska, and Iowa)

	1910–11	1911–12	1912–13	1913–14
MISSOURI				
Springfield	$0.67	$0.78	$0.70	$0.79
Joplin	.....	.79	.73	.76
St. Louis	.81	.87	.80	.76
St. Joseph	.....	1.78	1.83	1.69
Kansas City	1.65	1.81	1.96	1.77
KANSAS				
Kansas City	1.34	1.30	1.48	.....
Topeka	1.45	1.82	1.53	.....
NEBRASKA				
Omaha	.....	1.85	2.09	.....
IOWA				
Council Bluffs	.....	1.06	1.04	.....
Sioux City	.....	1.56	1.53	.....
Davenport	.....	1.71	1.55	.....
Des Moines	.....	1.86	1.72	.....
Cedar Rapids	1.68	2.12	1.49	.....

COST OF COAL PER PUPIL IN DAILY ATTENDANCE IN EACH SCHOOL BUILDING IN KANSAS CITY, MISSOURI

1. Kensington	$0.735	S	40. Wendell Phillips	1.636	H
2. Sixty-first Street	0.783	S	41. Bristol	1.662	H
3. Askew	0.838	S	42. Linwood	1.684	O
4. Milton Moore	0.840	S	43. G. B. Longan	1.686	O
5. Henry C. Kumpf	0.883	S	44. Karnes	1.712	H
6. Irving	0.944	O	45. Penn	1.734	S
7. Shiloh	0.956	S	46. Thacher	1.753	O
8. Jefferson	0.964	H	47. Blenheim	1.80	S
9. Manchester	1.019	S	48. Bruce	1.825	S
10. Woodland	1.023	O	49. Booker Washington	1.861	S
11. Swope	1.024	S	50. Wheatley	1.897	S
12. Hale H. Cook	1.049	S	51. Lykins	1.907	H
13. Emerson	1.058	S	52. Attucks	1.913	H
14. Washington	1.058	O	53. Mount Washington	1.915	H
15. Hamilton	1.101	O	54. Bancroft	1.944	O
16. Scarritt	1.102	O	55. Norman	1.962	O
17. Switzer	1.114	O	56. S. B. Ladd	1.963	H
18. Horace Mann	1.136	O	57. Douglass	1.972	S
19. Benton	1.147	O	58. Garrison	2.084	H
20. Greenwood	1.155	O	59. Adams	2.086	H
21. Frances Willard	1.178	S	60. Webster	2.110	H
22. Troost Avenue	1.184	H	61. Rollins	2.111	O
23. Lincoln	1.203	O	62. Swinney	2.135	S
24. Humboldt	1.212	O	63. Longfellow	2.146	H
25. Morse	1.215	O	64. Blue Valley	2.164	S
26. William Cullen Bryant	1.254	S	65. Jackson	2.204	S
27. Martin	1.277	S	66. Special	2.262	S
28. Whittier	1.311	O	67. Marlborough	2.337	S
29. James	1.323	O	68. Seven Oaks	2.515	S
30. Hyde Park	1.357	O	69. McCoy	2.817	S
31. Fairmount	1.362	S	70. Sumner	2.848	S
32. Lowell	1.384	O	71. Graceland	2.851	S
33. Van Horn	1.409	H	72. Benjamin Harrison	2.896	S
34. Faxon	1.419	O	73. Clay	2.954	H
35. Yeager	1.424	O	74. J. S. Chick	2.980	S
36. Franklin	1.475	H	75. S. O. Allen	3.426	S
37. Ashland	1.480	O	76. E. C. White	3.454	S
38. Allen	1.536	O	77. Lathrop	3.891	H
39. Garfield	1.600	O	78. Madison	4.596	H
Manual Training High	1.905	O	Central High	4.079	O
Westport High	2.251	O	Northeast High	4.904	S
Lincoln High	2.694	O			

O=oil. S=soft coal (bituminous). H=hard coal (anthracite or semi-anthracite).

From the table on p. 122 it is seen that the cost per pupil for coal in Kansas City, Missouri, averages higher than the cost in any other city in

this group of states except the city of Omaha. The average cost is more than 20 per cent greater than in Kansas City, Kansas, more than 10 per cent greater than in Topeka, Kansas, and more than double the cost in St. Louis, Missouri. A large part of this latter difference is accounted for by the fact that St. Louis buys the best grade of Illinois lump coal (bituminous) at a very low rate. This year St. Louis has contracted for its coal at $1.91¾ per ton, whereas Cherokee coal costs the Kansas City school district $3.54 per ton and is not so good a quality of coal as the Illinois lump. While this difference in the price and quality of the coal will account for a large part of the difference in the cost in St. Louis and Kansas City, it does not account for all of it. It would seem from these figures that the cost in Kansas City is from 10 to 20 per cent higher relatively than the cost in St. Louis or than the cost in the neighboring towns in Kansas.

Group I.—The largest group of school buildings is heated by steam hot-blast. There are 28 schools in this group. The lowest cost in this group was $1.102 per pupil in the Scarritt School, and the highest cost was $3.454 per pupil in the E. C. White School. It would seem that it

TWENTY-EIGHT BUILDINGS HEATED BY STEAM HOT-BLAST AND THE COST PER PUPIL

Scarritt	$1.102	Whittier	1.311
Switzer	1.114	James	$1.323
Horace Mann	1.136	Hyde Park	1.357
Benton	1.147	Van Horn	1.409
Greenwood	1.155	Faxon	1.419
Humboldt	1.212	Franklin	1.475
Morse	1.215	Ashland	1.480

		Percentage above Median Cost			Percentage above Median Cost
Allen	$1.536	2	Norman	$1.962	30
Garfield	1.600	6	S. B. Ladd	1.963	30
Linwood	1.684	11	Rollins	2.111	40
G. B. Longan	1.686	11	Benjamin Harrison	2.896	92
Thacher	1.753	16	*Clay	2.954	96
Lykins	1.907	27	E. C. White	3.454	130
Attucks	1.913	27	Median cost	1.508	...
Bancroft	1.944	29			

* Investigation has developed the fact that in this new 18-room building only 11 rooms were occupied, but that all 18 were kept heated all winter. The heat should have been cut off from 7 of these rooms and thus more than one-third of the cost saved.

should not cost more than $1.51 per pupil to heat these buildings, since one-half of the buildings were heated for less than that cost. Note that seven buildings in this group were heated for less than $1.22 per pupil. This might indicate that $1.20 to $1.25 per pupil is a fair cost for heating such buildings when the firing is properly managed. No school in this group has less than eight rooms. The Faxon and the Clay buildings are both new and built on the same plan.

Group II.—The second largest group of school buildings is heated by direct steam. There are 16 in this group. The lowest cost in this group is the Irving, $0.944 per pupil, and the highest cost is the Longfellow, $2.146 per pupil. The median cost is $1.331. However, it will be noted that 6 of this group are heated for less than $1.06. It would seem from the very nature of the case that direct steam heat should be cheaper than steam hot-blast. Hence it would seem that $1.05 to $1.10 per pupil is a fair cost for such heat.

SIXTEEN BUILDINGS HEATED BY DIRECT STEAM

Irving	$0.944	Yeager	$1.424
Jefferson	0.964	Phillips	1.636
Woodland	1.023	Karnes	1.712
Emerson	1.058	Garrison	2.084
Washington	1.058	Adams	2.086
Hamilton	1.101	Webster	2.110
Lincoln	1.203	*Longfellow	2.146
Martin	1.277	Median cost	1.331
Lowell	1.384		

* An incompetent janitor is named as the explanation of the high cost in the Longfellow.

Three other groups of elementary school buildings were studied in a similar manner.

Group VI. High Schools.—

Manual Training High	$1.905	Central High	4.079
Westport High	2.251	Northeast High	4.904
Lincoln High	2.694		

The cost here is necessarily greater than in the elementary schools, as more cubic feet of space per pupil must be heated. However, in some of these schools the cost seems excessive, especially in the Northeast High School, with a cost of $4.90 per pupil. The operation of the air-washer adds something to the cost of the heating in this building. The

fact that the building stands in the open and is fully exposed also adds to the cost. After a reasonable allowance is made for this additional cost, the still excessive cost would indicate one of two things: incorrect and wasteful methods of firing or improper fire grates or fire boxes causing excessive waste of fuel. A saving of $1,000 to $2,000 on the coal bill of this building would seem possible. It is impossible at this season of the year, August, to determine the real cause of this high cost. However, this may be worked out during the next school year.

GENERAL CONCLUSION

It seems evident that by proper attention on the part of the janitors to correct methods of firing and of economizing fuel an annual saving of from $5,000 to $10,000 could be made in the district.

The cost per 1,000 cubic feet to be heated may be fairer than the cost for each pupil, but the dimensions of the buildings were not available for this study.

Note 1.—Three kinds of fuel are used—oil, soft coal, and hard coal. Some allowance must be made for varying cost of the kinds of fuel.

Note 2.—In 1915–16, the Central High School will be opened. This building is very similar to the Northeast Building and will be heated by slack fed into the furnace by mechanical stokers. This will enable an accurate comparison of the cost of heating in the two buildings to be made. In the Northeast High School soft coal is used; oil is used in all the other high-school buildings.

Such studies as this show conclusively the need of standards for the cost of heating, lighting, water, supplies, janitor service, etc.

B. STUDY OF SCHOOL PROGRESS

The following study was made of the Kansas City, Missouri, ward-school graduates of June, 1915.

Just before the close of the school year the following "Individual School History" blank was sent to each member of the graduating class by the Bureau of Research and Efficiency:

INDIVIDUAL SCHOOL HISTORY

SEVENTH-GRADE PUPILS

1. Name.....Street Address.....
   (Write surname first)
2. When were you born? Year....., Month....., Day.....
3. Where were you born?.....
4. What will be your age June 11, 1915? Years...., Months...., Days....
5. Did you attend kindergarten?..... When?..... Where?.....
   How many months?.....
6. In what year and month did you first enter school (not kindergarten)?
   Year....., Month.....
7. Where did you first enter school?.....In what grade?.....
8. How old were you when you first entered school (not kindergarten)?
   Years....., Months.....
9. Have you attended school a part or all of each school year since you entered school?.....
10. How many school years or parts of school years have you attended school?
    .....
11. Have you ever missed as much as five (or more) consecutive months of school? List below each such absence from school:

	When (year)?	Number of months?	Why?	In what grade?
a.	.....	.....	.....	.....
b.	.....	.....	.....	.....
c.	.....	.....	.....	.....

12. When did you first enter school in Kansas City?.....
    In what grade?.....
13. Have you at any time repeated a grade or a class? If so, what grades or classes?.....
    .....
14. Have you at any time skipped a grade or class? If so, what grades or classes?.....
    .....

Careful directions were sent as to the method that should be pursued and the care that should be exercised in answering the questions, in order that the answers might be as accurate as possible; though the children depended upon their own memory and that of their parents, it is felt that in most respects the answers are fairly accurate.

It will be noticed that many of the questions are so put that the answers serve as a check upon each other. The papers were carefully

examined before the study was made, the answers compared and checked, and corrections made wherever it was evident an error had been made.

In this study we had in view the following problems: (1) to determine the time required to finish in the seven-year system which is in force in the Kansas City schools (boys and girls were kept separate in the study); (2) since about one-half of this class had a year's work in the kindergarten before entering the grades, a secondary problem was to determine the length of time required to finish by kindergarten children and also by non-kindergarten children (those who had not had work in kindergarten) and to compare the progress of the two groups in the matter of time required to finish; (3) some secondary problems that are omitted here.

It is felt that the first problem is of special interest because Kansas City has only seven years in the elementary-school course.

All children who entered the Kansas City schools after 1910 were excluded from this study in order that all children included might be placed upon an equal footing in regard to the school system. In doing this it was assumed that the difference in the first two years' work would not be very great, whether in a seven-year or an eight-year system, and that a child having had two years' work outside of Kansas City would usually enter the third grade upon coming to Kansas City. When a pupil was absent more than one-half the year, that year was not counted as a school year for him. Of the 2,084 white graduates in 1915, 378 were excluded and 1,706 were used for this study.

TABLE I

NUMBER OF PUPILS STUDIED, INCLUDING KINDERGARTEN AND NON-KINDERGARTEN

	Boys	Girls	Total
Number of pupils studied.....	847	859	1,706
Number of kindergarten pupils.....	417	406	823
Number of non-kindergarten pupils...	430	453	883

Table II shows that this class was about equally divided between seven and eight years in time required to finish; that a small number, 96, required less than seven years, and 239 required more than eight

years. Five pupils finished in five years. Four of these were non-kindergarten pupils and were overage at entrance into school.

TABLE II

NUMBER FINISHING AND YEARS REQUIRED

	NUMBER OF YEARS TO FINISH								
	12	11	10	9	8	7	6	5	Total
Number of boys, non-kindergarten	0	5	12	73	192	133	12	3	430
Number of girls, non-kindergarten	1	0	14	50	206	159	22	1	453
Number of boys, with kindergarten	0	0	8	48	145	189	26	1	417
Number of girls, with kindergarten	0	0	5	23	142	205	31	0	406
Total	1	5	39	194	685	686	91	5	1,706
Percentage, total	0.05	0.29	2.28	11.37	40.21	40.15	5.33	0.29	100
Percentage, non-kindergarten boys and girls	0.12	0.57	2.95	13.93	45.07	33.07	3.85	0.45	100
Percentage, kindergarten boys and girls	0.00	0.00	1.58	8.63	34.87	47.87	6.92	0.12	100

Table III shows that the class as a whole required about seven and two-thirds years to finish the course, a saving of about 0.75 of a year over the eight-year system, since the average time required in most eight-grade systems is about 8.4 years. The time required for the girls is slightly less than that for the boys.

TABLE III

AVERAGE TIME REQUIRED	Years
Average time for all boys and girls	7.65
Average time for all boys	7.72
Average time for all girls	7.58

Table IV, which is a comparison of kindergarten and non-kindergarten children, shows that in the matter of time required to

TABLE IV

COMPARISON OF TIME REQUIRED BY KINDERGARTEN AND NON-KINDERGARTEN CHILDREN

	Non-Kindergarten	Kindergarten
Average time required, boys and girls	7.80	7.50
Average time required, boys	7.87	7.56
Average time required, girls	7.72	7.42

finish the kindergarten children have an advantage of about three-tenths of a year over the non-kindergarten children. The kindergarten girls also finish in less time than the kindergarten boys. An average of only 7.42 years was required by the kindergarten girls.

Table V is another comparison of the time required to finish. In making this study, the necessity for a system of cumulative records whereby the advancement of a child through the grades can be traced accurately became clearly evident.

TABLE V

TIME REQUIRED TO FINISH

	7 Years or Less	8 Years or More	Total
All, boys and girls	782	924	1,706
All, kindergarten boys and girls	452	371	823
All, non-kindergarten boys and girls	330	553	883
Kindergarten boys	216	201	417
Kindergarten girls	236	170	406
Non-kindergarten boys	148	282	430
Non-kindergarten girls	182	271	453

C. OPPORTUNITY OF INDIVIDUALS

The following summaries taken from the reports on double promotions, special promotions, and special demotions give an insight into the chance that the individual will have his special needs met and that he will be considered apart from the mass or group.

TABLE VI

DOUBLE PROMOTIONS DURING THE SECOND THIRTEEN WEEKS OF THE YEAR 1914–15

First grade	22	Fifth grade	9
Second grade	18	Sixth grade	6
Third grade	18	Seventh grade	1
Fourth grade	14	Total	88

Combining the 88, the 436, and the 420 cases of Tables VI, VII, VIII, we have only 944, or less than 3 per cent of the elementary-school enrolment, that received special promotions, demotions, or double promotions during one-third of last year. Are there not more pupils needing this special attention? From Table VII it is to be noted that it is two and one-half times easier to secure a special promotion in the same room than to a higher class in another room (315 were promoted within rooms, and only 121 to other rooms). It would appear that the barrier between rooms must be somewhat greater than between classes in the same room, though such a circumstance clearly ought not to operate to limit the child's opportunity.

TABLE VII

SPECIAL PROMOTIONS TO HIGHER CLASSES

	In Another Room	In Same Room
First grade	52	72
Second grade	21	57
Third grade	20	59
Fourth grade	6	42
Fifth grade	15	62
Sixth grade	7	19
Seventh grade	0	4
Total	121	315

TABLE VIII

SPECIAL DEMOTIONS TO LOWER CLASSES

	In Another Room	In Same Room
First grade	60	70
Second grade	28	29
Third grade	38	34
Fourth grade	10	24
Fifth grade	22	32
Sixth grade	17	34
Seventh grade	11	11
Total	186	234

While these summaries indicate that nearly all the pupils of the schools are moved forward in mass, it is very probable that the oppor-

tunity for individual adjustment is somewhat greater than is here indicated, for two reasons: First, the form of report used was new and in several cases it was evident that errors had been made, and the reports were returned for correction. However, in other cases the reports may not have been understood and errors may have been made. Secondly, the most probable form of error would be a failure to report special promotions and demotions by oversight or because of failure to keep a record of all such cases.

While the majority of pupils are average pupils and should move in mass, there is a considerable number of especially slow pupils and also of especially bright pupils that should not be sacrificed to mass movement.

It is very comforting to note that the figures given above show 16 more special promotions than special demotions. This means that the bright children are being given a chance. The bright children need special opportunities for advancement as well as the slow children.

The problem of meeting the needs of the individual pupil in city-school systems is still an unsolved one. It baffles both teachers and school administrators. One forward step has been made in that the problem has been recognized. For years teachers and school superintendents refused to admit the existence of such a problem. Some progress is being made in the solution of the problem through supervised study hours, special-help periods, more individual instruction, and less mass teaching.

D. EFFICIENCY OF SCHOOL WORK

In measuring the efficiency of teaching, the median results for the entire city were computed. These results were furnished to each principal and thus it was possible for a principal to compare each room in his building with the city medians and determine where added emphasis was needed or where improved methods were needed. In handwriting a test was made and the following directions were given the pupils in October:

PUBLIC SCHOOLS, KANSAS CITY, MISSOURI

PUPIL'S DIRECTION

Write as well as you can at your usual speed the following stanza. Write the stanza again and again until I say "Stop." At the command, stop at

once, even if in the middle of a letter. Use a line of paper for each line of stanza. Use no punctuation marks.

Speak the truth
In the end it shall appear
Truth is best in age and youth

The teachers and principals were directed to have each pupil read this stanza twice before beginning to write, to have the pupils write exactly two minutes, and to have no writing on the papers except the stanza—no name, no grade, no school, and no number. The samples in each building were collected by rooms and grades, and each bundle was properly labeled. These samples were then given key-numbers, and put up in bundles of 150 to 200 papers each, and assigned to about one hundred teachers who were especially good in handwriting, who volunteered to score the papers by the Thorndike scale. When these papers were returned and the scoring studied, it was found that the standards of the scorers, even when the scale was used, were so different that the comparisons of rooms or buildings would be worthless. Then it was determined to take a group of normal-training-school students and train them to use the Thorndike scale. Twenty of these students were chosen. The material used was that devised by Dr. E. L. Thorndike and described in the *Teachers College Record* for November, 1914. The standard specimens were graded independently by the normal students on eight different days. After each grading a conference was held and specimens that were not accurately graded were studied more closely. Freeman's suggestions on grading handwriting were also read by the students. Although no effort was made to follow the Freeman plan, yet it perhaps had some influence in their grading. The standard specimens were cut apart, their numbers concealed, and then the specimens graded. Also at these daily conferences twenty samples of the students' writing were numbered serially and were graded by each of these normal students, and the twenty students then compared their results on each of these specimens. In this way, in about two weeks they became so skilful that they varied only 3 to 5 per cent on a group of twenty papers. This body of twenty students then for a small stipend graded 57,863 writing samples. The ranges and medians for the city are given in Tables IX–XI.

Mr. Freeman's standards (Table XII) are for an eight-grade system. For the Kansas City schools with a seven-grade system the standards

TABLE IX

RANGES IN CLASS MEDIANS IN QUALITY-HANDWRITING

Grade	October	May	M–O	H
VII	8.1–11.5	8.4–14.0	8.5–14.0	8.8–13.8
VI	7.9–11.2	8.2–11.9	8.2–14.1	8.5–13.2
V	7.5–10.3	7.5–11.0	7.1–11.6	8.3–12.0
IV	7.5– 9.7	7.1–10.9	7.1–10.1	6.3–12.2
III	6.8– 9.6	6.8– 9.9	7.0–10.0	6.8–11.1
II	.....	5.9– 9.0	.....	6.2–10.1
I	.....	.....	.....	5.5– 9.3

October = October papers.
May = May papers.
M–O = May papers of the same pupils that were in these grades in October.
H = Special papers collected by the writing supervisor.

TABLE X

RANGES IN CLASS MEDIANS IN SPEED-HANDWRITING

Grade	October	May	M–O
VII	17.5–119.0	50.5–118.0	50.5–118.0
VI	34.0– 93.0	35.5–111.0	35.5–105.5
V	21.5–107.0	49.5–100.5	50.5– 99.0
IV	11.5– 83.0	39.0– 91.5	44.5– 81.0
III	14.5– 63.5	29.5– 69.0	30.5– 83.0
II	.....	15.5– 78.0	.....

TABLE XI

CLASS MEDIANS IN HANDWRITING

Grade	Quality				Speed		
	October	M–O	Gain	H	October	M–O	Gain
VII	9.5	10.6	1.1	11.4	72	77	5
VI	9.1	9.9	0.8	11.0	65	76	11
V	8.7	9.4	0.7	10.5	60	69	9
IV	8.2	8.8	0.6	9.3	49	64	15
III	8.0	8.2	0.2	8.4	35	53	18
II	.....	.....	.....	7.6	.....	.....	.....
I	.....	.....	.....	7.2	.....	.....	.....

of Table XIII are proposed. It is to be noted that the quality suggested for the seventh grade is only 12. These standards are for the quality of work at the end of the year. A pupil who on completing the sixth grade writes quality 11.5 on the Thorndike scale at the rate of 80 letters per minute has reached the sixth-grade standard in writing.

TABLE XII

FREEMAN'S PROPOSED STANDARD FOR QUALITY AND SPEED IN HANDWRITING
(The quality is converted into units of the Thorndike scale instead of the Ayres' units)

	SCHOOL GRADE						
	II	III	IV	V	VI	VII	VIII
Quality.....	8.0	8.4	9.1	10.0	10.7	11.6	12.7
Speed.....	36	48	56	65	72	80	90

TABLE XIII

PROPOSED STANDARDS FOR KANSAS CITY SCHOOLS—SPEED AND QUALITY

	SCHOOL GRADE					
	II	III	IV	V	VI	VII
Quality.....	7.5	8.5	9.5	10.5	11.5	12.0
Speed.....	36	48	60	70	80	90

That these standards are easily attainable is indicated by the fact that in May the six rooms doing the best work in each of the various grades of the city averaged 0.6 of a Thorndike point above the standard in quality proposed, and also averaged 21 letters per minute above the standard in speed. Even in October, the six rooms doing the best work averaged only 0.5 of a Thorndike point below the proposed quality, and the average speed in October of these rooms was 10 letters per minute above the standard. It is not expected that every pupil in a room will reach the standard set, but the majority should reach the standard, and the higher the quality of teaching, the fewer will be the exceptions. The standard quality and speed should be maintained in all written work.

Good teaching and good grading keep pupils of like ability together. When a pupil reaches the standard in writing for his grade, he may give

his attention to other studies. The presence in a room of a few especially good writers is no guaranty of good teaching. They are usually natural exceptions. In some cases, indeed, they are actually the products of poor teaching—the kind of teaching that takes care of the promising pupils to the neglect of the remainder.

In October, 1,743 of the writing papers were worth 12 or more; this was about 11 per cent of the whole number of papers graded. At the same time 2,076 pupils wrote more than 90 letters per minute. It is a waste of time to require pupils who can write quality 12 at the rate of 90 letters per minute to continue practice in writing. The sixty hours of school time usually devoted to writing each year should be devoted to other work by pupils who have reached the standard. All attempts to train beyond a reasonable standard result in much waste of time and energy. Of the special papers prepared for Mr. Holt in May, 3,650, or about 18 per cent, were graded 12 or above. These people are doing satisfactory writing, and 2,400 of these pupils are below the seventh grade. It is possible that the high quality of these papers was obtained at the sacrifice of speed.

These facts show conclusively that there are large numbers of the elementary-school pupils who write well and rapidly. A school system should be judged, not by its best nor by its poorest product, but by its average product. The average writing product in the Kansas City schools, while comparing very favorably with the average product in other systems, is not quite so good in quality or in speed as it should be. With definite standards to be reached and close supervision by the writing supervisor, in a year or two at most the standards proposed should be reached by practically all rooms. In fact, a few entire school buildings have now reached the standard. Some buildings last year gained nearly 2 Thorndike points between October and May. However, the standard calls for only 1 point advance each year. Hence, schools below standard should be able, by extra effort, to advance to standard.

Mr. Freeman, in discussing his proposed standards in handwriting, says:

> The data which have been presented indicate that this standard can be attained with an expenditure of time of not over 75 minutes a week. The writer is convinced on the basis also of some of the data that it could be attained generally, as it is in some cases, by the expenditure of a much shorter amount of time. When the most efficient methods are employed, it will

probably be found that the expenditure of from ten to fifteen minutes in the intermediate grades suffices to fix the handwriting habit in its main outline, and that the expenditure of a small amount of time in the upper grades will maintain the efficiency of the habit and increase it by the amount of progress which is represented in the standard.

From the investigations made thus far I am of the opinion that generally, not only in Kansas City, but in other cities, too much emphasis is placed on writing in the lower grades. With well-directed work in Grades III, IV, V, writing can be fairly well mastered. Increased speed and improved quality in the sixth and seventh grades will come with very little practice—one or two ten-minute periods per week—if right habits have been established in the intermediate grades.

Rooms below standard are advised to make an "extra effort" on penmanship. This does not mean additional time, but better methods of teaching, more specific and purposeful drills, a closer study of the needs of the class, the elimination of waste, and more corrective individual work. Without doubt ample time is spent in the teaching of penmanship in all the grades and too much time in some grades.

CHAPTER XII

THE EFFECTS OF EFFICIENCY TESTS IN READING ON A CITY SCHOOL SYSTEM

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At the request of the committee the following brief statement is made of the effects of a series of tests in reading on the teachers and administrators of a school system. It is not the purpose of this paper to repeat the tables showing the numerical results of these tests, but rather to comment briefly on the significance of the tests for the system of schools.

In the beginning the teachers were somewhat skeptical as to the purpose of the tests. Some thought that it was an attempt to check up the work of the individual teacher as a basis for determining his or her efficiency. There was no large amount of experience in the system itself in the giving of tests or in the evaluating of results. The selection of the subject to be investigated was determined in part by the interests of the supervisors and in part by the suggestions derived from earlier scientific studies on reading.

After a number of conferences between the superintendent and the supervisors of the system, the following program was adopted as a suitable one for a series of tests: (1) to ascertain the rate of reading, both oral and silent, as it is now taught in this system of schools; (2) to ascertain the relation that the rate of reading of one grade bears to its next higher grade as a standard of advancement; (3) to ascertain what factors are of greatest influence in affecting the rate of reading; (4) to ascertain the relation that the rate of reading bears to the result achieved in the process of reading considered as a thought-getting process.

The immediate result of the tests was to call the attention of the teachers to many problems of method which had heretofore entirely escaped their attention. Their original notion was that the way to teach reading is to read, read, read. The moment they began to perform these tests, it became evident to them that the child, in learning to

read, is facing a multitude of difficulties without being guided by any definite notion of how to proceed. In fact, they learned that it is important for the teachers, as well as for the students, to make distinctions that heretofore had escaped their attention. This is well brought out in the following quotations from individual grade teachers:

1. "We do not know how to teach silent reading."
2. "We had not realized the importance of efficiency in silent reading as related to the rest of the subjects."
3. "We are going to emphasize silent reading and the grasp of content."
4. "We will not teach oral reading less, but silent reading more."
5. "The problem is ours. We will assist in its solution."
6. "We have a new interest in teaching reading."

A brief summary may be given of the general and specific results which came from the series of tests.

GENERAL

1. The attitude of pupil and teacher toward the subject changed.
2. The utility of silent reading stressed.
3. Greater emphasis placed on the proper method of presenting and conducting reading-lessons, especially so far as the rate of reading and the grasp of content are concerned.
4. Closer correlation of reading with the other subjects.

SPECIFIC

1. A more definite standard for judging the efficiency of reading.
2. A more elastic system of promotion by subjects.
3. Closer attention to the individual differences of pupils in reading ability, thus adapting more closely the type of training to the individual pupil.
4. A greater economy of time effected in teaching the subject.
5. Greater intelligence and interest in the use of standards and tests in judging results of teaching.

Perhaps many of these results may seem to the reader overstated. However, great care has been taken in the formation of these judgments to ascertain and formulate premises based upon the direct experience of teachers who are daily presenting the work in the classroom. The results seem to indicate that the study has been very beneficial in

achieving higher quality of teaching, not only in reading but in other subjects as well.

At the time of writing this article teachers of the English department in the high school (unsolicited) brought the report that pupils in the language department showed much greater preparation than in former years. This improvement in language is believed to be in part due to the emphasis on the reading work of the elementary schools.

This, with other evidences, seems to justify the belief that the school system itself has been greatly improved through the interest aroused in this study. Let me mention especially four ways in which the entire system is affected:

1. A more scientific attitude and method in the subject is established.
2. A closer checking-up of results is obtained.
3. More definite teaching is practiced.
4. More efficient learning results.

CHAPTER XIII

INVESTIGATION OF SPELLING IN THE SCHOOLS OF OAKLAND, CALIFORNIA

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An extensive investigation of the subject of spelling was made in the Oakland schools during the past year, covering Grades II–VIII inclusive, in forty of the forty-one schools of the city. In addition to an examination of the general administrative policy affecting spelling, the schedules of time-allotment, the content of the course, lesson-assignments, and methods and devices in use in the classrooms, a test of the efficiency of spelling was made by the use of the Ayres Springfield lists.[1] The tests were applied to 12,985 children.[2]

The tests were all given on the same day, to the younger children in the forenoon, and to the older children in the afternoon. The words were pronounced in the usual way by the classroom teacher, in the presence of a member of the investigating staff (some fifty advanced students of education had been carefully instructed for this purpose). The words were marked, partly by students, and partly by principals and teachers. No principal or teacher marked papers from his or her own school.

The purpose of the study was to get together the facts necessary as a basis for a scientific handling of this branch of the curriculum, to interpret these facts in the light of sound principles of administration, supervision, and teaching, and to make the results available for study by those engaged in supervising or teaching the subject.

The results of the tests were expressed in terms: first, of group averages; secondly, of the distribution of individual scores within these groups; thirdly, of individual differences due to (*a*) age, (*b*) sex, and (*c*) general ability (teacher's estimate); fourthly, of social differences

[1] These lists have since been embodied in a complete spelling scale. See Leonard P. Ayres, *Measurement of Ability in Spelling*. New York: Russell Sage Foundation, 1915.

[2] The full report is published by the Oakland School Department as *Publication No. 1* of the Bureau of Information, Statistics, and Educational Research, June, 1915.

due to (*a*) father's occupation, (*b*) father's nationality, (*c*) the child's occupational ambition, and (*d*) the child's home language; fifthly, of the relation between time-allotment and spelling ability.

In terms of the standard (70 per cent) the averages for the city as a whole, for all but three of the separate schools, for all grades but second and third, rank high. The average score for the city is 76.5 per cent. The difference between averages attained by different schools is wide; the higher scores are attained by the larger schools. In some schools grade averages vary but slightly, while in other schools such variation is extremely wide. Also, when the scores of all the children in the city are averaged by grades, these averages vary as much as 24 per cent, and the variation of class averages within a given grade is even wider still, while the distribution of individual scores within a class, a grade, or a school, ranges from zero to perfect. And since 21 per cent of all the children in the city made perfect scores, it is evident that the test was inadequate.

The overlapping between grades and the wide difference between scores attained by different schools and by different grades show that there is no common standard for promotion in this subject.

Incident to the study of scores in the light of individual differences the schools were found to be over 60 per cent retarded. Every grade contained children at least eight years apart in ages, and a careful study showed that the accelerates invariably scored higher than their grade averages, while retardates regularly fell below, and the more retarded the lower their scores.

The influence of sex, while not pronounced, is fairly constant, with a tendency to increase with age. And the correlation between general ability (teacher's estimate) and ability to spell is constant and marked.

Differences between the scores of different social groups, as indicated above, appear, but they are not pronounced, and the effect of the home language, either as to extent or type of errors, is practically negligible.

There is no evidence in the results of the tests, nor in other information gathered, to show that spelling is standardized in respect to content, method, length of lesson-assignment, time-allotment, or amount to be learned. From the standpoint of group averages the schools stand high, but from the distribution of individual scores it is evident that important individual and social differences do not enter as determining factors in the organization and teaching of the subject.

CHAPTER XIV

STANDARD TESTS AS AIDS IN THE CLASSIFICATION AND PROMOTION OF PUPILS

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The two chief sources of waste in education are (1) teaching things that the bright pupils already know and (2) teaching things that none of the pupils need to know. Economy in the latter will be achieved by ascertaining what the really essential and important things in each subject are. Economy in the former will be achieved by classifying and promoting pupils, not according to time, but according to ability.

One third of the pupils waste time by being in classes in which they know practically all the material that is being covered in the recitation period and are able to perform all the tasks expected of them. Another third of the pupils waste time by being in classes in which they can grasp very little of the material and are able to perform very poorly, or not at all, the tasks expected of them.

One pupil out of every three is promoted too slowly and one pupil out of every three is promoted too rapidly. One pupil in every three could finish the eight grades in seven years or less, and one pupil in every ten could finish the eight grades in six years or less. The reason for this situation is that the schools do not know in any accurate way the actual abilities of their pupils and are unable to compare in any precise manner the abilities of the pupils with one another. The result is that there are no definite, tangible standards with which the pupil of any given grade can be compared so as to ascertain whether he is up to the standard or not.

I shall now attempt to show by concrete examples the basis of these assertions and the means by which a more accurate classification of the pupils may be brought about.

Standard tests in reading, writing, spelling, and arithmetic were carried out in an elementary school in Madison composed of approximately 350 pupils. The results of these tests are shown for each subject and for each grade by the distribution-curves in the following figures.

Let us examine first the performance of the pupils in writing. The tests were designed to measure speed and quality of writing and were performed according to the specifications published by the writer in the *Journal of Educational Psychology*, February, 1915. The speed of writing was expressed in terms of the number of letters written per

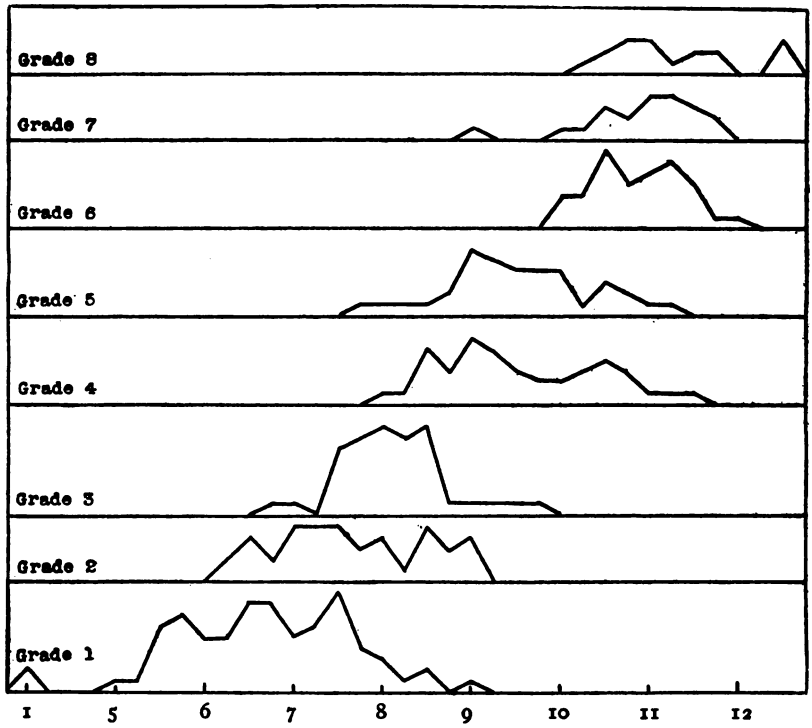

CHART I.—Distribution of pupils in writing in Grades I–VIII. The numbers along the base-line are the scores expressed in terms of the Thorndike scale.

minute, and the quality was measured by the Thorndike scale. By a process of equating speed and quality so as to express a pupil's writing ability in a single score, all the results were evaluated and represented in the curves of Chart I. The numbers along the base-line from left to right are qualities on the Thorndike scale. The distances vertically above each base-line represent the number of pupils. Thus it will be seen that the pupils in the first grade range all the way from quality 4 to

quality 9, and the pupils in the second grade range all the way from quality 6.25 to quality 9. The striking fact is the enormously wide range of abilities in each grade and the resulting overlapping of the abilities of one grade over those of the other grades. By actual computation, 32 per cent of the pupils in any given grade equal or exceed the median of the next grade above it. A corresponding percentage of pupils equals or falls below the median of the next grade below.

The tests in reading were designed to measure speed and comprehension and were made according to the specifications published by the writer in the *Journal of Educational Psychology*, January, 1915. The reading ability of each pupil is represented by a single score in which his performances in speed and in comprehension are combined. The results are shown in Chart II in a manner similar to that met in Chart I. The facts for reading are similar to those for writing. The range of ability in each grade is enormously wide, and the overlapping is likewise extensive. In the case of reading, 31 per cent of the pupils in any given grade reach or exceed the median of the next grade above.

The tests in spelling were made with the lists published in the *Journal of Educational Psychology*, March, 1915. The distributions and overlappings, as shown in Chart III, are in all essential respects identical with the two preceding tests. Twenty-three per cent of the pupils of any given grade reach or exceed the median of the next grade above.

Ability in arithmetic was measured by means of the Courtis tests, Series A. It was found that 32.5 per cent of the pupils in any given grade reach or exceed the median of the next grade above.

The question which now arises is this: Would not the range of ability and the overlapping be very much less if each pupil's performance in all studies were combined? Thus, a fourth-grade pupil might write as well as the average seventh-grade pupil and read as well as the average fifth-grade pupil, but spell no better than the average first-grade pupil. His average performance in all studies combined might be approximately what it should be for the fourth grade.

What are the actual facts? A combined score for all studies was computed for each pupil, so that the various subjects were balanced against each other. It was found that even then the overlapping was practically as large. Thirty-two and two-tenths per cent of the pupils in any given grade reach or exceed the standard of the next grade above

it; thirty-five and two-tenths per cent fall to or below the standard of the next grade below. The schools have not been able to measure in any accurate manner the actual abilities of the pupils, nor to compare them with any objective standards.

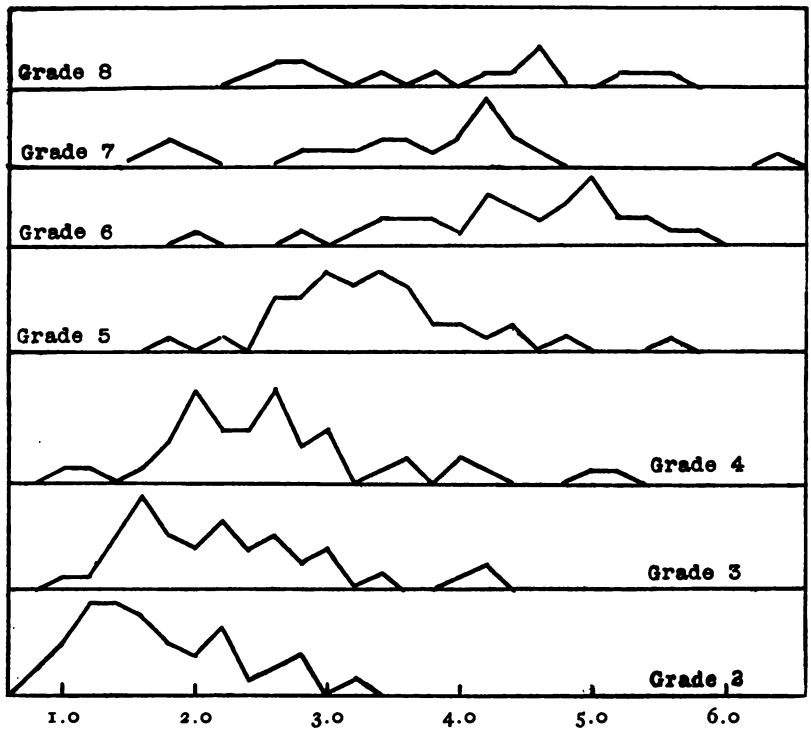

CHART II.—Distribution of pupils in reading in Grades II–VIII. (The numbers along the base-line are the scores in which speed and comprehension are combined, but expressed in terms of words read per second.)

It is obvious that a considerable economy in time could be effected by classifying and promoting pupils according to their actual abilities or performances in the various studies. One-third of the pupils are one or more years ahead of the grade in which they are placed and could, therefore, complete the elementary school one year earlier and be fully up to the standard of the average eighth-grade pupil.

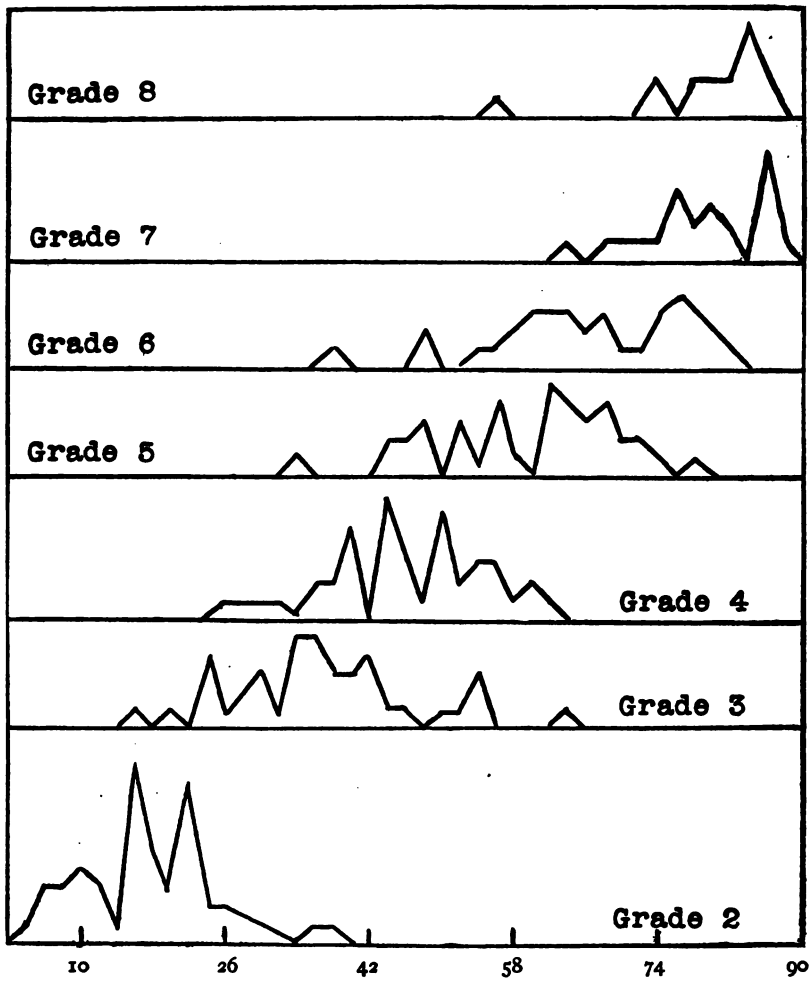

CHART III.—Distribution of pupils in spelling in Grades II–VIII. (The numbers along the base-line represent the percentage of words spelled correctly in the specified lists.)

Every school system ought to have a department of testing by means of standard scales and tests, so that the actual abilities and achievements of pupils could be rated accurately and made use of in classification and promotion. The principle of promotion according to ability rather than according to time would also have the advantage of acting as an incentive to the pupils to do their best.

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THORNDIKE, E. L. *Handwriting*. Teachers College, Columbia University.

CHAPTER XV

THE USE OF MENTAL TESTS IN THE SCHOOL

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The object of mental tests, practically considered, is to secure by a relatively refined and precise method a more accurate determination of the mental traits or the general mental status of a pupil than can be secured by other methods, as by inspection of his marks or his school progress or by the teacher's personal estimate. Roughly speaking, the mental tests now available for use with school children are of two sorts: first, those which aim to determine with some precision the presence or the absence or the amount of some specific mental characteristic, e.g., tests of memory-span, of quickness of learning, of pitch discrimination, of color-blindness, etc.; secondly, those which aim to determine with perhaps somewhat less precision the general status of the child's intelligence, his mental level or general all-round ability as related to that of other children of the same nationality, sex, age, and social status. In this second field the Binet-Simon tests have received such preponderant emphasis and attention as to constitute at present almost the only system of tests of general intelligence with which the educational public is acquainted.

In principle, the first sort of tests—those which bring to light specific mental abilities—are of most decided interest and importance for the work of the schools. In practice, they have received almost no attention from school men, and it is impossible because of that, and more especially because they necessitate the participation of an investigator who possesses special training in general, experimental, and applied psychology and a good acquaintance with schoolroom problems, to urge at this time any wholesale adoption of them in public-school systems. What we should urge is that, in those school systems in which the conditions are favorable for the development of educational research, there should be created the office of *consulting psychologist* and that this official should be commissioned to make intensive studies of all sorts of special

cases in which the analysis of mental abilities and disabilities would throw light upon the means of instruction that would accomplish maximal results for school progress. There is no school system of any size that does not contain dozens and scores of pupils who present special psychological problems. Examples are: pupils that cannot learn to spell, pupils that have special difficulty in committing to memory, pupils that are slow in acquiring the technique of reading, pupils that display exceptional gifts in special lines of work, pupils that seem to be tone-deaf, pupils that present peculiar and seemingly inexplicable resistance to disciplinary control, pupils that exhibit speech disorders developed from compulsory right-handedness. In fine, the painstaking scrutiny and intensive study of all individuals that exhibit striking peculiarities in their mental equipment is a form of educational research that is greatly to be desired, that some of our best-equipped school systems could readily afford, and that demands for its prosecution the application by an expert of numerous special forms of mental tests.

Tests of the second sort—test-systems designed to measure general intellectual status—have come into considerable prominence in the past decade through the interest developed by the Binet-Simon tests. These tests were first proposed in 1905 by the eminent French psychologist, Alfred Binet, and his collaborator, the physician, Dr. Simon, in response to an inquiry as to what devices might be used to segregate, for placing in special classes, pupils too defective mentally to profit by instruction in regular classes. This preliminary statement was replaced in 1908 by a more systematic formulation and this 1908 series was again replaced three years later by what is known as the 1911 revision. The extraordinary cleverness with which they were devised, the novelty of the principles they embodied, and their surprisingly satisfactory outcome from the schoolman's point of view, all conspired to focus upon these tests the active attention of psychologists and educators in all civilized countries. The extent of this activity may be gauged by the number of titles, 254, in the Binet-Simon bibliography published by Kohs in 1914. One consequence of this activity has been a flood of criticism, both constructive and destructive, which renders anything like an authoritative standardization of every detail of procedure in the application of these tests quite out of the question at the present time. Fortunately, however, from the immediately practical point of view, it is unnecessary to go into these technical details of criticism.

This report, then, will be limited to demonstrating by reference to several typical studies in American cities that the Binet-Simon tests are valuable devices for the administration and organization of school systems, to pointing out certain limitations in the tests, and to suggesting certain precautions that should be observed in their use.

As typical studies of the usefulness of the tests in this country we shall cite those by Goddard[1] (1911), Dougherty (1913), Adler (1914), Brigham (1914), and Hicks (1915).

Goddard reports upon the testing of all the pupils (2,000) of the public schools of Vineland, New Jersey, wherein it was found that 78 per cent of the pupils were "normal," in the sense of being either "at age," one year "advanced," or one year "retarded" when their mental is compared with their chronological age. Pupils testing two or three years behind their age, 15 per cent of the school population of the first six grades, are regarded as "merely backward," and as needing to be placed in special classes in order to profit adequately by instruction. Pupils testing four or more years behind their age (3 per cent of these were found) are ranked as feeble-minded. Particular attention is called to the equally serious misfits on the other side of the curve of distribution, i.e., to those gifted children who are not placed in the school grade which their mental attainments indicate. "Nothing could be clearer," says Goddard, "than the way in which these figures [referring to one of his tables] demonstrate what we all know from experience must be true, that is, that we drag the dull child up, trying to keep him up to his grade and hold the bright child back to keep him to the same grade, thus doing gross injustice to both." The following excerpts from his results are sufficiently typical to show what amount of disparity exists between the actual grading of children and the grading indicated by the Binet tests.

	Number	Percentage
In grades above what Binet scale would warrant.....	121	9.4
In grades corresponding to what Binet scale would warrant..	558	43.2
In grades below what Binet scale would warrant.....	558	43.2

The question at once arises: How far should the school be expected to show conformity to the Binet results in its grading? To this we may return later. Suffice to say that after all allowance is made, there

[1] Consult the references at the end of this chapter for sources.

remain many cases in which pupils are wrongly placed, and that the Binet scale offers one method of bringing the discrepancies to light.

In 1913 Miss Dougherty reported upon the results of Binet tests applied to 483 pupils of the public schools of Kansas City, Kansas, whose ages ranged from six to seventeen years and whose school grades ranged from the first to the eighth. While expressing the hope that the scale may be improved in certain details, this investigator quotes as directly applicable to her own results the following statement of Goddard (in the report above cited):

> It is almost beyond the bounds of possibility that we should get such figures as are shown in this table [a general distribution of results] unless the figures upon which it is based are amazingly accurate, and if they are accurate it gives us a wonderfully valuable method of measuring our efficiency and our accuracy in the grading of children, and points out the possibility of great improvement along this line—much to the advantage of the children and the comfort of the teacher.

Miss Martha Adler, assistant principal of Public School 77, New York City, reported in 1914 the results of two experiments upon the classification of pupils on the basis of Binet testing. In her first experiment 80 first-grade boys were tested in the middle of the year and the 35 who stood highest were placed together as the advanced section, while the remainder formed the regular section. Both sections were then carried forward as fast as their abilities would permit. The result was distinctly better progress for *both* sections than under ordinary methods of sectioning, that is, on other bases than mental ability. Her second experiment dealt with 89 fourth-grade boys; the general plan was similar and the results were similarly striking. Miss Adler is convinced that the Binet tests are worth while, not only for the pupils, but likewise for teachers and supervisors. Her experiments are of interest because they demonstrate the utility of mental tests for the classification of "normal" pupils into sections *within* the regular classes. On the need of such classification she says:

> Although a large majority of pupils enter school at six, a difference in their mentalities is manifest almost at the outset, and after a few weeks two or three groups are formed to provide for the different grades of intelligence. In other words, there are three classes in one class. Allowing for the most efficient instruction, and for a skilful use of that educational time-killer "busy work," we are nevertheless forced to admit that there is an incredible amount of time

wasted, and almost superhuman energy expended in attempting really to supervise two groups while teaching a third. In the higher grades the grouping is usually done sparingly, because of the sheer impossibility of covering the mass of subject-matter laid down in any way except by class instruction. Subject-matter increases in importance as the child advances—in fact, we are too much bound by a curriculum, and classifications, gradations, and groupings are made with reference to it, rather than with reference to the pupils. What we need is something which will increase the importance of the child's individuality.

In the same year, 1914, C. C. Brigham published results secured by applying the Goddard 1911 revision of the Binet-Simon scale to 309 pupils in the first six grades of the Princeton Model School. Brigham concludes that the scale not only graded accurately "in the long run" pupils of from seven to eleven years of age (there were too few cases at six years to generalize from), but was also "an adequate measure of individual differences at any of these ages." "This conclusion," he adds, "may be qualified by defining 'accurately measured' as a correct measure 96 per cent of the time, but there is strong probability that this measure approached complete accuracy."

During the past year, 1915, Vinnie C. Hicks, consulting psychologist of the Oakland, California, schools, has reported tests of all the children in a kindergarten of that city to discover whether the results showed a good correlation with the actual school progress of the children. Her final conclusion is that "the Binet tests given to entrants to the first grade would not result in any unjust labeling of them as mental defectives." On the contrary, "the most evident fault of the tests, if used as prognosticative of school progress, is over-optimism." Again she says: "The chief value of giving the tests would be in having them productive of proper distribution of entrants according to ability, into regular classes, classes for the slow but intelligent, special classes for the subnormal, expulsion [from the classes of the regular school system] for the feeble-minded."

The foregoing citations from five studies in American public-school systems represent, it will be understood, only a fraction of the available material.[1] They are adduced here as being enough to demonstrate that

[1] From Wallin, (*Mental Health of the School Child*, chap. xviii) it appears that the Binet tests are in use in at least the following American cities: Albany, Allentown, Altoona, Auburn, Aurora, Baltimore, Birmingham, Bloomfield, N.J., Buffalo, Cambridge, Camden, Chester, Cincinnati, Cleveland, Columbus, Dayton, Detroit, Denver,

the Binet-Simon tests can be used to distinct advantage in the classification and grading of school children from the very first day of their work in the schools. It goes without saying that the use of the tests in this manner presupposes the actual organization within the school system of sections or groups of pupils classified in accordance with the tests. This is not the place to discuss the details of such organization, save to point out that every bit of the evidence indorses a plan of organization which embodies more than two such sections of groups within each of the usual school grades. Eventually, we shall undoubtedly seek to develop in all school systems at least four groups: the gifted group, the regular group, the slow group, and the group of moderately defective mentality. A fifth group—the mental defectives whose insufficiency is marked—will be relegated to special custodial institutions. This plan of organization will be recognized as essentially the one widely and favorably known as the Sickinger, or Mannheim, system, now in operation in Germany.

Stress has been laid in the preceding paragraphs upon the adequacy of the Binet-Simon tests in the differentiation of "normal" children into groups of approximately similar mental abilities. If the tests are adequate for this differentiation, it follows, *a fortiori*, that they are unquestionably adequate for the detection and segregation of the distinctly mentally defective group, including both the more serious cases that need institutional treatment and the less serious cases that need instruction in special classes in the public-school system. On this account no specific citations will be made here to the very extensive literature upon the use of the tests for organizing special classes for mental defectives, though this is the field in which the tests have been most often used and for which they were originally designed.

It remains, now, to consider certain limitations of the Binet tests and to note certain precautions that should be observed in their use.

Elizabeth, Englewood, Everett, Wash., Goldsboro, N.C., Grand Rapids, Hackensack, Harrisburg, Hibbing, Minn., Hoquiam, Wash., Houston, Jersey City, Lakewood, Ohio, Little Rock, Long Branch, Los Angeles, Louisville, Malden, Mason City, Iowa, Minneapolis, Montclair, Mount Vernon, Morristown, Muskegon, Mich., Newark, New Britain, New Brunswick, New Haven, New Orleans, North Bergen, N.Y., Newton, Oakland, Cal., Passaic, Perth Amboy, Philadelphia, Pittsburgh, Plainfield, Princeton, Raleigh, Reading, Richmond, Rochester, N.Y., Saginaw, St. Louis, Schenectady, Somerville, Mass., Somerville, N.J., Spokane, Springfield, Mass., Toledo, Trenton, Washington, West Hoboken.

Every expert who has dealt with the tests has found points to be criticized in them. No one claims that they are ideal or even as perfect as might be from a practical standpoint. Nearly everyone agrees that the tests of the lower school ages—up to the eighth year—are too easy, and that those of the higher ages—especially above the eighth year—are somewhat too difficult. The composition of the several tests has been criticized freely: some of them are felt to depend too much on school training; some of them are quite certainly wrongly placed (even in Binet's 1911 revision); others are condemned on the ground that they offer a one-to-one chance of success by mere guessing; still others are admittedly difficult to score. Similarly, the composition of the series for the several years is open to discussion; need is felt for an extension of the series above twelve years, and possibly for the insertion of finer gradations in the lower years; the interpretation of the data, particularly when certain tests are missed in the earlier years and others passed in the later years, offers much chance for debate. These and other criticisms can be offered against the Binet scale. Nevertheless, they are sufficiently met for our present purposes by the one outstanding fact that the tests, even with these imperfections, *do* work. School men need not cast aside an educational device just because it is open to improvement.

More important, in our opinion, than these details of improving the technique of the scale is the possible misinterpretation of what the tests really do for us. It should be understood, for example, that they do not pretend to afford a precise and comprehensive view of the mental aptitudes of the pupil. They tell us merely that, taken as a whole, a given pupil can do approximately those things that most children of a certain age can do. But in another way, two pupils might both test eight years mentally and yet be very different from one another; an imbecile who tests eight years and who is actually twelve years old has quite a different mind after all from the normal eight-year-old child.

Again, it is important not to forget that even if the tests should measure native ability ideally, still we should not expect a complete correspondence between the test results and school progress, for the fairly obvious reason that school progress depends on other factors than native ability. Industry and zeal, good home-conditions, docility, inclination for "bookish" pursuits, freedom from illness, conformity to the school routine, these and other factors play their rôle. The point is, however, that these conditions are relatively accessible to modification

and control, whereas native ability, in the nature of the case, is a primary and uncontrollable prerequisite for school success. It follows that the determination of the general intellectual status cannot be neglected, even though some pupils of moderate ability are able to get higher marks than other pupils of superior ability.

In the actual administration of the Binet tests there arise several important questions. One of these, in particular, has aroused considerable debate. Must these tests be administered by a specially trained expert or may they be administered by any classroom teacher? On this point there is disagreement. Our opinion is between the extreme views. We should recommend the employment wherever possible of an expert psychologist who has had experience, not alone in the psychological laboratory, but also in the conduct of mental tests generally, and who is also familiar by personal contact with the various forms of mental deficiency to be found in institutions for the feeble-minded, who could qualify, in short, as an expert psycho-clinicist.[1] But, where circumstances prevent the employment of an expert psycho-clinicist, we are of the opinion that selected teachers may be trained to perform the most necessary selection of mentally defective pupils with sufficient accuracy to warrant the adoption of this plan. We would recommend that these teachers should be able to present most, if not all, of the following qualifications: (1) at least a general familiarity with the classroom work of the grade schools, (2) a degree of general intelligence better than the average of elementary-school teachers, (3) familiarity with general elementary psychology, educational psychology, and, preferably also, experimental psychology, (4) familiarity with the main aspects of personal hygiene and of school hygiene (with special emphasis upon physical defects and their relation to mentality), (5) knowledge of the history, aims, methods, and results of the special classes for mentally defective children as operated in public schools, (6) special drill in the administration of mental tests, including the technique of the Binet scale, and knowledge of the principal proposals for its modification and extension, (7) personal observation of numbers of feeble-minded children

[1] The proper qualifications for psycho-clinical work have been set forth at length by J. E. W. Wallin, whose views may be taken as an example of those who would restrict diagnostic work with mental tests to persons of quite varied and exceptional training and experience.

as gathered in institutions for mental defectives.[1] Opportunities to secure this special training are now offered by a number of universities, particularly in their summer-school courses. It is also gratifying to note that several of the institutions for the care of the feeble-minded are opening their classes for observation and practice work to limited numbers of properly qualified teachers and supervisors of special classes for mental defectives. We would recommend that school boards directly or indirectly subsidize selected teachers to enable them to secure adequate training in this field.

Another question often debated is: Which of the numerous formulations of the Binet tests should be used? In our opinion, for the purposes of such classification as is here recommended, little or no difference will appear in the results from the use of different formulations. When the basal year is ten or over, we incline to favor the arrangement of the tests proposed by Kuhlmann or by Terman (known as the Stanford revision) rather than the earlier and more frequently used "standard method" published by Goddard, simply because a number of the modifications tentatively introduced by the last-named have been found to be undesirable. Yet the Goddard formulation has the merit of greater ease in handling and administering. It is, moreover, in more common use than the others. Its results are equally good for ages under ten. The *Teachers' Manual* prepared by Professor R. A. Schwegler (14), and published by the School of Education of the University of Kansas, has also an excellent account of this scale and a verbatim set of directions for its conduct.

Whatever arrangement of the scale is used, there are certain general directions for testing that are important if standardized results are to be obtained. The following may be deemed especially essential:

[1] These recommendations accord with the resolution adopted by the American Psychological Association, at its Chicago meeting, December, 1915, deprecating the use of mental tests for purposes of practical diagnosis by persons psychologically unqualified for such work. Since the purport of this resolution has been wrongly stated in certain newspapers, where it has been declared that the American Psychological Association "put its ban on the Binet tests," it would seem not inappropriate here to warn school officials against supposing that the Binet scale has been officially discredited by professional psychologists and against supposing that any person, regardless of training, is competent to apply the scale and either to commend or condemn it.

1. *Isolation.*—Conduct the test individually in a quiet, well-lighted room, free from interruption, and without the presence of parents, teachers, or other children. An assistant, who shall record all responses verbatim, may be used to advantage when time is to be economized.

2. *Preliminary observation.*—Don't start the testing at once, but take a few minutes to get acquainted with the child and to disarm suspicion or timidity. We have found it useful to measure weight, height, vital capacity, strength of grip, vision, and even hearing (quite roughly), and with younger children to try the form-board. These physical tests are directly interesting to the child and they often reveal to the examiner physical defects that account for what seems to be mental insufficiency. Naturally, this preliminary observation must not be long enough to wear out the child before the Binet tests are begun.

3. *Encourage.*—Avoid anything that suggests an inquisition. Never show impatience. Never ridicule. Be tactful and sympathetic. Never correct the child. Never state flatly that his answers are wrong.

4. *Avoid pumping.*—Amateurs almost invariably read into the child's responses their own knowledge. In consequence, they proceed to "pump" the right answer out by hinting, suggesting, and quizzing: "You mean thus and so, don't you?" "Isn't it really this?" etc.

5. *Follow directions.*—The besetting sin of the amateur tester is his proneness to modify the conditions of administering the tests. It cannot be said too emphatically that the primary rule in the use of mental tests is: "Follow directions." Put negatively, if the slang be permitted: "Don't monkey with your method." In especial, don't alter the instructions given to the child in the tests.

6. *Sidelights.*—Be on the watch for the numerous indirect indications of the child's mental processes. To the skilful examiner the attitude and manner of the child will convey valuable hints supplementary to the actual replies. Make full notes on the record blank of these accessory symptoms of mentality.

7. *Order of tests.*—Begin with a number of relatively simple tests. The pictures and the definitions, for example, are always interesting and frequently supply the examiner at the outset with an approximate notion of the child's status. Do not follow strictly the order on the record blank. Intersperse difficult with easy tests.

8. *Range of testing.*—The narrowest range permissible is from the lowest age at which all the tests are passed to the highest age at which

any single test is passed. If the results show considerable irregularity (much "scattering"), it will be necessary to widen this range.

9. *Recording.*—If no stenographic or clerical assistance is feasible, make the attempt, nevertheless, to set down, as soon as it is made, a full record of the child's responses. It is impossible to fill these in later from memory. Moreover, it frequently becomes desirable to know afterward, not merely that the child passed or failed in a given test, but just precisely what his response was.

10. *Anamnesis.*—It is usually worth while to record a tolerably full account of the child's personal history, since it is impossible to be sure that this information will not be wanted afterward in dealing with the case. The following items are recommended: (*a*) child's name in full, (*b*) sex, (*c*) date of birth, (*d*) name of school, (*e*) school grade, (*f*) date and hour of examination, (*g*) name of examiner, (*h*) name of person proposing the examination, (*i*) name of teacher, (*j*) names and addresses of parents, (*k*) occupation of parents, (*l*) number of children in family and their sex, (*m*) illnesses of pupil, (*n*) obvious physical defects or peculiarities, (*o*) conduct in school, (*p*) proficiency in school,(*q*) other items pertinent to the child in question.[1]

REFERENCES

(NOTE.—These references are restricted in the main to the articles referred to in this report. For a full bibliography of the Binet tests, up to 1914, consult Kohs; for an extended presentation of the present status of psycho-clinical work and of the organization of special classes consult Wallin and Goddard.)

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CONSTITUTION OF THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

(Revision Adopted in Chicago, February, 1909)

ARTICLE I

Name.—The name of this Society shall be "National Society for the Study of Education."

ARTICLE II

Object.—Its purposes are to carry on the investigation and to promote the discussion of educational problems.

ARTICLE III

Membership.—SECTION 1. There shall be three classes of members—active, associate, and honorary.

SEC. 2. Any person who is desirous of promoting the purposes of this Society is eligible to active membership and shall become a member on approval of the Executive Committee.

SEC. 3. Active members shall be entitled to hold office, to vote, and to participate in discussion.

SEC. 4. Associate members shall receive the publications of the Society, and may attend its meetings, but shall not be entitled to hold office, or to vote, or to take part in the discussion.

SEC. 5. Honorary members shall be entitled to all the privileges of active members, with the exception of voting and holding office, and shall be exempt from the payment of dues.

A person may be elected to honorary membership by vote of the Society on nomination by the Executive Committee.

SEC. 6. The names of the active and honorary members shall be printed in the *Yearbook*.

SEC. 7. The annual dues for active members shall be $2.00 and for the associate members $1.00.

ARTICLE IV

Officers and Committees.—SECTION 1. The officers of this Society shall be a president, a vice-president, a secretary-treasurer, an Executive Committee, and a Board of Trustees.

SEC. 2. The Executive Committee shall consist of the president and four other members of the Society.

SEC. 3. The president, vice-president, and secretary-treasurer shall serve for a term of one year. The other members of the Executive Committee shall serve for four years, one to be elected by the Society each year.

SEC. 4. The Executive Committee shall have general charge of the work of the Society, shall appoint the secretary-treasurer, and may, at its discretion, appoint an editor of the *Yearbook*.

SEC. 5. A Board of Trustees consisting of three members shall be elected by the Society for a term of three years, one to be elected each year.

The Board of Trustees shall be the custodian of the property of the Society, shall have power to make contracts, and shall audit all accounts of the Society, and make an annual financial report.

SEC. 6. The method of electing officers shall be determined by the Society.

ARTICLE V

Publications.—The Society shall publish *The Yearbook of the National Society for the Study of Education* and such supplements as the Executive Committee may provide for.

ARTICLE VI

Meetings.—The Society shall hold its annual meetings at the time and place of the Department of Superintendence of the National Education Association. Other meetings may be held when authorized by the Society or by the Executive Committee.

ARTICLE VII

Amendments.—This constitution may be amended at any annual meeting by a vote of two-thirds of voting members present.

MINUTES OF THE MEETING OF THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION AT CINCINNATI, OHIO, MONDAY, FEBRUARY 22, 1915

An audience of some five hundred persons assembled in one of the ballrooms at the Sinton Hotel in order to hear the discussion of Part I of the *Fourteenth Yearbook* of the Society, while some two hundred persons were turned away, owing to the fact that the room was filled. This unusually large number was due to the fact that the Yearbook entitled *Minimum Essentials in Elementary-School Subjects* made such a wide appeal and to the fact that it represented the co-operative efforts of the National Society for the Study of Education and the Committee on Economy of Time of the National Education Association.

President J. M. Gwinn called the meeting to order at 8:00 o'clock, and presided during the progress of the following program:

Topic: "Minimum Essentials in Elementary-School Subjects." General Statement of the Scope of the Yearbook.

J. M. GWINN, Superintendent of Schools, New Orleans, La.

"The Essentials in Language and Literature"

JAMES FLEMING HOSIC, Head of Department of English, Chicago Normal College, Chicago, Ill.

"Objective Standards for Controlling Instruction and Economizing Time"

S. A. COURTIS, Director of Educational Research, Public Schools, Detroit, Mich.

"Standard Requirements in Handwriting"

F. N. FREEMAN, Assistant Professor of Education, University of Chicago, Chicago, Ill.

Discussion:

G. D. STRAYER, Professor of Educational Administration, Teachers College, Columbia University, New York, N.Y.

F. E. SPAULDING, Superintendent of Schools, Minneapolis, Minn.

The report of the nominating committee was presented and the following officers elected: President, Superintendent R. J. Condon, of Cincinnati; Vice-President, Professor J. Carleton Bell, University of Texas; Member of Executive Committee for the term expiring in 1919, President Dwight B. Waldo, of the Western State Normal School, Kalamazoo, Mich.; Member of the Executive Committee to fill the vacancy caused by the resignation of Superintendent H. C. Morrison, Superintendent Harry B. Wilson, of Topeka,

Kan.; Member of the Board of Trustees, Professor S. Chester Parker, University of Chicago.

At approximately 10:00 o'clock the chairman adjourned the meeting, which had proved to be especially successful, largely owing to the fact that each speaker was thoroughly well prepared and spoke exactly the length of time that had been assigned him.

S. CHESTER PARKER, *Secretary*

J. M. GWINN, *President*

FINANCIAL REPORT OF THE SECRETARY-TREASURER OF THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

DECEMBER 23, 1914, TO DECEMBER 23, 1915

RECEIPTS FOR 1915

Balance on hand December 23, 1914			$1,087.28
From sale of *Yearbooks* by The University of Chicago Press:			
June to December, 1914	$347.49		
January to June, 1915	912.97	$1,260.46	
Interest on savings bank account:			
To January 1, 1915	$ 12.98		
To July 1, 1915	6.25	19.23	
Dues from members (current and delinquent):			
Active	$387.80		
Associate	219.30		
		$607.10	
Total income for the year			$1,886.74
Total receipts including initial balance			$2,974.07

EXPENDITURES FOR 1915

Publishing and distributing "Yearbooks":		
Printing *Fourteenth Yearbook*, Part I ("Minimum Essentials")	$499.69	
Distributing *Fourteenth Yearbook*, Part I, to members	35.54	
Printing 1,200 additional copies *Fourteenth Yearbook*, Part I	184.50	
Printing *Fourteenth Yearbook*, Part II ("Teachers' Efficiency")	239.19	
Distributing *Fourteenth Yearbook*, Part II, to members	25.13	
Printing 1,000 additional copies *Twelfth Yearbook*, Part I ("Supervision of City Schools")	79.36	
Printing 1,015 additional copies *Fourteenth Yearbook*, Part II	76.10	
Miscellaneous expenses preparing *Yearbooks*	20.13	
Distributing *Yearbooks* to members, miscellaneous	9.77	
Total cost of *Yearbooks*		$1,169.41
Carried forward - - - - - - - -		1,169.41

Brought forward - - - - - - - - -		$1,169.41
Secretary's office:		
Secretary's salary from end of Richmond meeting, February, 1914, to end of Cincinnati meeting, February, 1915	$100.00	
Secretary's traveling and hotel expenses for Cincinnati meeting	49.10	
Typewriting	21.20	
Bookkeeping	31.25	
Stamps	30.00	
Stationery	17.85	
Telegrams	5.31	
Exchange	6.70	
Total for Secretary's office		261.41
Total expenses		$1,430.82

SUMMARY

Total expenditures for 1915		$1,430.82
Balance on hand December 23, 1915 — Savings account		1,292.13
Balance on hand December 23, 1915 — Checking account		251.12
Total		$2,974.07

MEMBERSHIP

Number of active members (including one honorary) December 23, 1915	195
Number of associate members December 23, 1915	242
Total membership	437

GUY M. WHIPPLE, *Secretary-Treasurer*

LIST OF ACTIVE AND HONORARY MEMBERS OF THE NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

(Corrected to January 15, 1916)

HONORARY MEMBERS

Dewey, John, Columbia University, New York, N.Y.

ACTIVE MEMBERS

Allen, Fiske, State Normal School, Charleston, Ill.
Arbaugh, W. B., Ypsilanti, Mich.
Ashley, L. S., Sibley, Ill.
Axline, Howard E., West Technical High School, Cleveland, Ohio.
Bachman, R. H., Tarboro, N.C.
Bagley, William C., University of Illinois, Urbana, Ill.
Baldwin, Bird T., Swarthmore College, Swarthmore, Pa.
Ballou, Frank W., care of School Committee, Mason St., Boston, Mass.
Barnes, Harold, Girard College, Philadelphia, Pa.
Becker, Ernest J., Eastern High School, Baltimore, Md.
Bell, J. Carleton, University of Texas, Austin, Tex.
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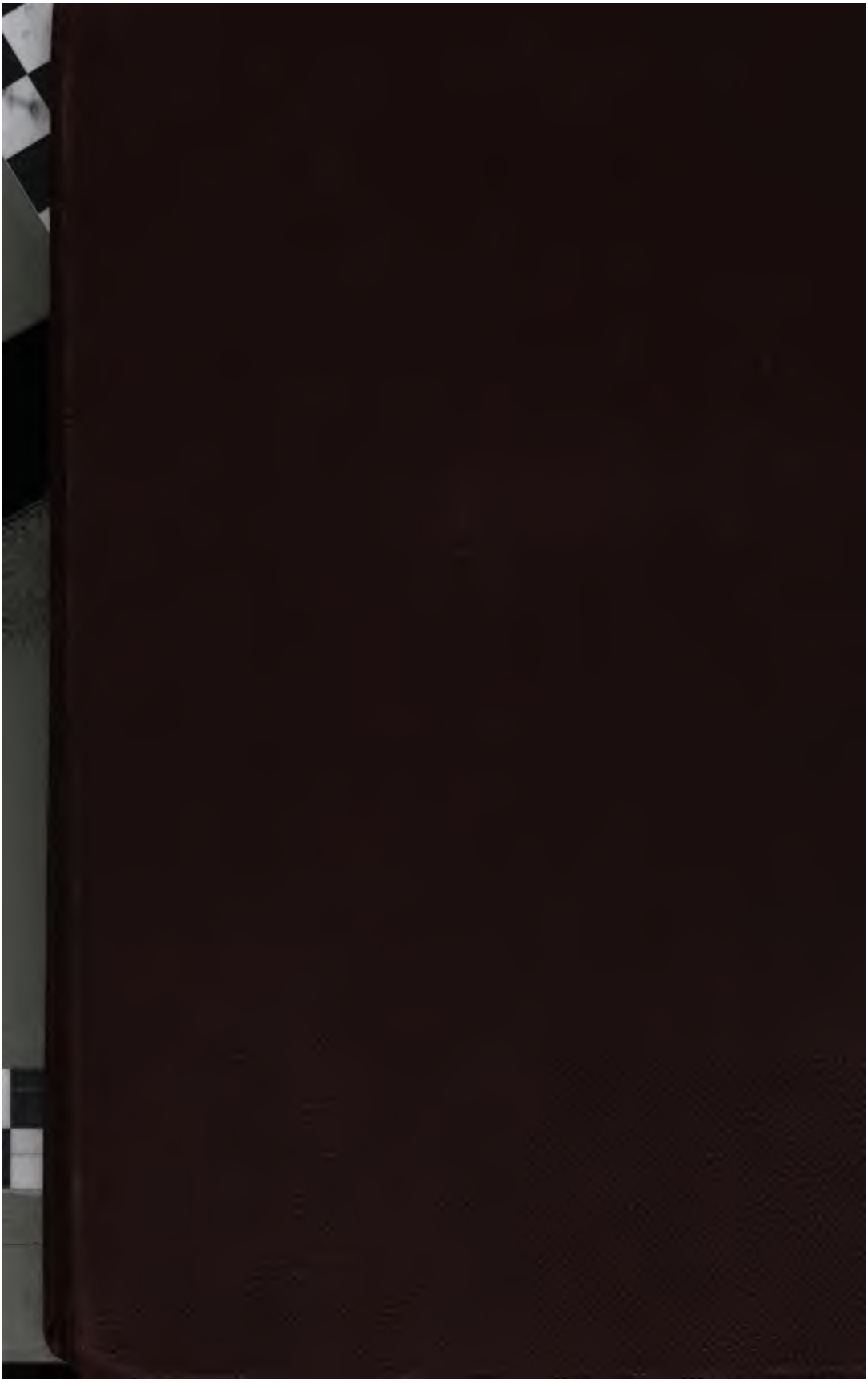
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